AD-A127 465 BROOKVILLE LAKE GREATER MIAMI RIVER BASIN INDIANA 1/2
EMBANKMENT CRITERIA AND PERFORMANCE REPORT(U) ARMY
ENGINEER DISTRICT LOUISVILLE KY SEP 82

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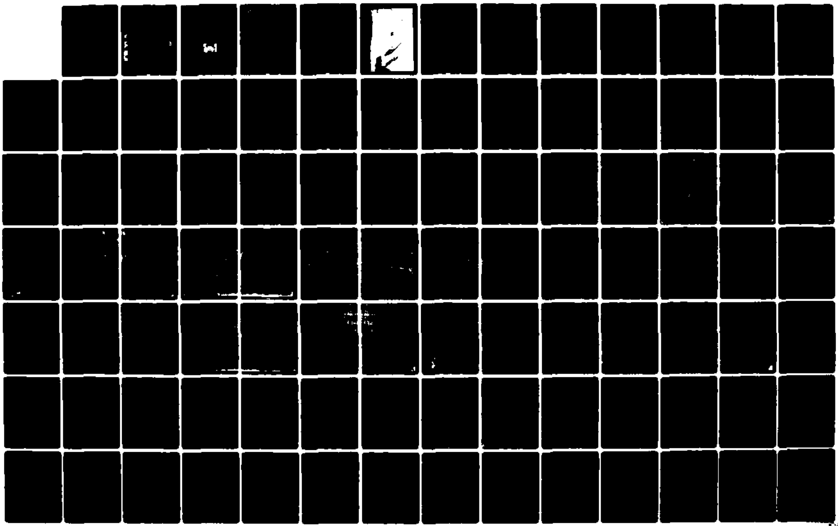

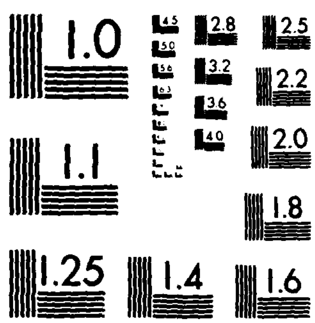

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Construction Notes	Shear Test Data
Foundation-Abutment Treatment	Seepage Control
Slope Stability	Operational Notes
Diversion-Closure	Instrumentation

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The embankment criteria and performance report provides a summary record of significant design data, design assumptions, design computations, specification requirements, construction equipment, construction procedures, construction experience, field control and record control test data and embankment performance as monitored by instrumentation during construction and during initial lake filling.

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12

BROOKVILLE LAKE

GREATER MIAMI RIVER BASIN

INDIANA

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

PREPARED BY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS

SEPTEMBER 1982

DEPARTMENT OF THE ARMY
LOUISVILLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 59
LOUISVILLE, KENTUCKY 40201

ORLED-G

6 April 1983

SUBJECT: Embankment Criteria and Performance Report, Brookville Lake, Indiana

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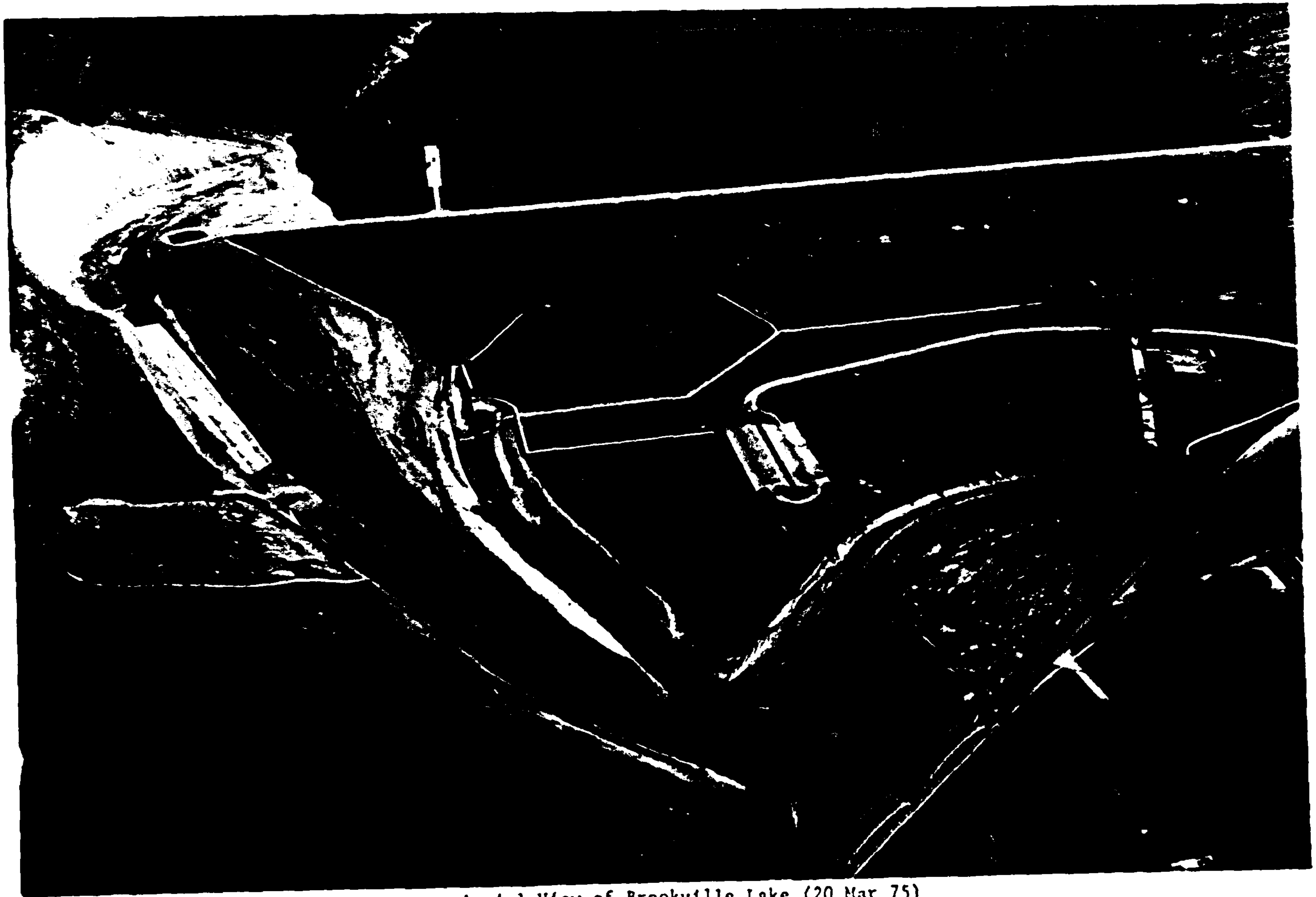
BROOKVILLE LAKE
EAST FORK WHITEWATER RIVER
INDIANA

EMBANKMENT CRITERIA
AND
PERFORMANCE REPORT

Prepared by
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS

SEPTEMBER 1982



Aerial View of Brookville Lake (20 Mar 75)

BROOKVILLE LAKE
EAST FORK WHITEWATER RIVER, INDIANA
EMBANKMENT CRITERIA AND PERFORMANCE REPORT

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AND PERFORMANCE REPORT

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BROOKVILLE DAM

EAST FORK OF WHITEWATER RIVER, INDIANA

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

PERTINENT DATA

1. Authority for Project. Flood Control Act approved 28 June 1938 (Public Law 761, 75th Congress, First Session).

2. Purpose of Project. To furnish flood protection in the Whitewater and Miami River Valleys and to reduce flood stages at all points downstream along the Ohio River. The project is a unit in the general comprehensive plan for flood control and allied purposes in the Ohio River Basin. A secondary purpose of the project is to provide a pool for recreation and fish and wildlife activities.

3. Location of Project. The dam is located on the East Fork of White River about 2 miles above the junction with the West Fork and near Brookville, Indiana. It is located 60 air miles east of Indianapolis, Indiana, and 30 miles northwest of Cincinnati, Ohio.

4. Drainage Area. Damsite 379 square miles.

5. Lake.

Item	(feet MSL)	Acres	Acre Feet	Inches Runoff
Minimum pool	713	2,250	55,600	2.75
Water supply pool	740	4,510	144,900	7.17
Seasonal pool	748	5,260	184,900	9.10
Flood pool	775	7,790	359,600	17.79
Allocated to flood storage	740-775	3,280	214,700	10.62
Allocated to seasonal flow regulation	740-748	--	39,100	1.93
Allocated to water supply	713-740	--	89,300	4.42

6. Dam.

a. Embankment.

Type	Earthfill
Top elevation	809
Maximum height, feet	181
Length, feet	2,900
Top width, feet	30

b. Spillway.

Type	Open cut through right abutment
Crest elevation	775

c. Outlet Works.

Type	Circular - concrete
Diameter, feet	12
Control gates, number, size, feet	2 service, 2 emergency 5.25 x 12 (service) 5.25 x 12 (emergency)
Invert elevation to outlet works	630

7. Land Acquisition.

Fee, acres	11,050

8. Relocations.

a. State Highways	Indiana 101, 8.8 miles Indiana 44, 0.5 mile
b. County Roads	Franklin County, one location, 3.9 miles Union County, nine locations
c. Electric, telephone, & other related utilities as required	

9. Public Access.

No. of Sites	7

10. Lake Clearing.

Area, acres	840

11. Hydroelectric Power. UNIT ADDED ON NOT OPERATIONAL YET

12. Annual Charges. $1,305,000

13. Annual Benefits.

a.	Flood control	$ 795,000
b.	Recreation	1,047,000
	Total	$1,842,000

14. Ratio, Benefits to Cost. 1.4 to 1

15. Construction Time. 4 years

BROOKVILLE DAM

EAST FORK OF WHITEWATER RIVER, INDIANA

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

1. General.

a. Authority. Authority for preparation of the Embankment Criteria and Performance Report for Brookville Dam is contained in ER-1110-2-1901, dated 1 Aug 72.

b. Project Purpose. Brookville Lake is a unit in the comprehensive plan for flood control and allied purposes in the Ohio River Basin. Operation of the lake will reduce flooding along the Whitewater River and through the City of Brookville on the East Fork and contribute to reduction of flooding along the short section of the Miami River before its entrance into the Ohio River.

c. Project Location. The project is located at Brookville, Indiana, in the southeast corner of the State about 60 air miles southeast of Indianapolis. The damsite is 35 air miles northwest of Cincinnati, Ohio, and 90 air miles northeast of Louisville, Kentucky. The lake area lies in Franklin, Fayette, and Union Counties, with its upper extremity near the southern border of Wayne County. The drainage area above the dam is 379 square miles. At the spillway crest level, elevation 775, the lake extends upstream from the dam a distance of 21 miles. The site plan is shown on Plates 1-4.

d. History of Construction. Contract DACW27-70-C-0079, Construction of Dam and Spillway, Brookville Reservoir, East Fork Whitewater River, Indiana, was awarded on 31 March 1970 to Guy H. James Construction Co. of Oklahoma City, Oklahoma, and notice to proceed was received on 25 April 1970. The contract was accepted as being physically complete on 5 June 1975.

Work began with some survey work on 30 April 1970 and clearing started on 27 May 1970, and stripping began on 16 June 1970.

The following is a compilation of significant starting dates.

27 May 1970	Started stripping dam foundation
7 July 1970	Change in horizontal drain Sta. 16+00 to 23+50 (Mod #1)
8 July 1970	Started placing embankment
23 July 1970	Changed granular material to random incline drain to centerline Sta. 10+00 to 21+00
28 July 1970	Started placing piezometers
24 Aug 1970	Started 2nd shift
16 Sept 1970	Started grouting lt. abutment
22 Sept 1970	Started excavation for toe drain system
23 Oct 1970	Started drilling relief wells
18 Dec 1970	Shut down embankment placement for winter
9 April 1971	Started placing embankment again
3 May 1971	Started excavating spillway

5 May 1971	Started excavating retreat channel
11 May 1971	Started excavating intake channel
17 Dec 1971	Shut down embankment placement for winter
3 April 1972	Started placing embankment again
8 July 1972	Diverted stream through outlet works
13 Nov 1972	Shut down embankment placement for winter
19 & 20 Dec 1972	Built shale dike on dam embankment to el. 717 protection
28 April 1973	Started placing embankment again
13 Oct 1973	Ended 2nd shift
16 Oct 1973	Embankment placement completed
5 June 1975	Job accepted as being physically complete

FOUNDATION AND ABUTMENT TREATMENT

a. Stripping. The foundation and required excavation extending 2,000 feet upstream of the toe of the dam was stripped of topsoil to clay or granular material. The topsoil was used in the 4-foot compacted earth slope protection on the downstream side of the dam.

b. Streambed. See Photos 5 through 7. The area of the first bottom and streambed excavation was stripped to undisturbed granular or

rock. The best of the material in this area was used in the random area while some materials had to be placed in the waste area below the dam.

c. Right Abutment. This area was very steep and was stripped with a frontend loader just ahead of the fill.

d. Cutoff Trench. The cutoff trench was cut to the top of the unweathered limestone and shale under the impervious core on both abutments. After grouting, the limestone ledges were swept clean just prior to placement of the impervious fill. See Photo Nos. 2 and 7.

e. Grouting. The grouting consisted of a single line grout curtain within the abutments beneath the cutoff trench. A horizontal distance of approximately 640 feet on the left abutment and approximately 620 feet on the right abutment was grouted. The drilling and grouting was done by zones, using the split spacing, stage grouting method with two zones. The primary holes were spaced on 20-foot centers and were drilled 20 degrees landward from vertical. The split spacing method was used for placing the secondary and tertiary holes, which were drilled and grouted as necessary at the direction of the field personnel. Due to the nature of rock, thin beds of limestone within shale, grouting pressure was 5 p.s.i. maximum. In the cutoff trenches, the soft shale created by the exposure period was removed to the limestone ledges after grouting. The final cleanup of the rock surface was performed just prior to the initial impervious placement.

f. Dewatering. In order to dewater the streambed, which is sand and gravel, a deep well was drilled 200 feet downstream of Station 23+75. The well was pumped continuously and dried up the area to just below the surface. To check the results of this method, three test pits were dug after 6 feet of material had been placed. The pervious contact was found to be in good condition.

g. Blanket Area. The required stripping upstream of the dam embankment was cut to clay or elevation 637 in the area of the blanket. Where the clay was encountered above 637, the area was drilled 6 feet deep on a 100-foot grid to make sure of a good cutoff. Granular material was not encountered in any borings.

h. Slides. Two slides developed on the right abutment in the dam foundation. The first was on 8 October 1970 on the upstream side of the cutoff trench Sta. 25+00 to 26+00± during the excavation of the cutoff trench. The second slide developed during placement from the downstream side of the cutoff trench extending downstream to the toe of the dam Station 27+00 to 29+00± on 7 May 1973. All loose material was removed to the slide plane as the embankment was placed. Photographs of these slide areas are included with the foundation report.

i. Material Quantities (Excavation).

(1)	Stripping dam foundation	3,631,000 cu. yd.
(2)	Spillway and channel	2,137,000 cu. yd.
(3)	Borrow	2,235,000 cu. yd.
(4)	Intake channel slide	11,000 cu. yd.
(5)	Spillway channel slide (Right side)	8,000 cu. yd.
(6)	Dam right abutment slide	20,000 cu. yd.

All useable material was placed in the dam. There was no separate computation for amounts placed in impervious, random granular or waste below dam in old streambed as all compacted fill with the exception of

filter zones was one bid item. A total of 6,574,000 cu. yds. of compacted embankment was placed.

EMBANKMENT

a. Sources of Embankment Materials. The materials used for construction were obtained from required excavation, spillway, retreat channel, intake channel and toe drainage system, and borrow area upstream of the dam. All areas produced some impervious, granular, and random materials with the bulk of random rock from the spillway and minor amounts from the intake and retreat channels.

b. Material was hauled to the dam in Caterpillar Models 666 and 647 scrapers with the exception of the incline drain material which was trucked to the site.

(1) Zone 1. Impervious material was spread in 8-inch layers with dozer blade and disc, wet or dried to within 2 percent $\pm$ of optimum moisture content and compacted with six passes of a Ferguson Self-Propelled Sheepsfoot roller.

(2) Zone 3. Granular materials were placed on the fill then spread and leveled in 8-inch layers with an A16 grader and compacted with four passes of a self-propelled 50-ton pneumatic (Loplant Choate) roller. In some instances when both 50-ton pneumatic rollers were broken down, a self-propelled vibrating (Tampo) roller was used to compact the lift until repairs could be made on one of the pneumatic rollers.

(3) Zone 2. Filter Drainage. The horizontal layer was hauled in scrapers, spread with a 16 grader in 8-inch layers and compacted with a self-propelled (Ferguson or Shovel Supply Co.) vibrating roller. The

sand for the inclined sand drain was hauled in trucks and dumped in small piles in the inclined drain and spread with a small dozer in 8-inch lifts and compacted with a minimum of four passes with a self-propelled vibrating roller. When additional moisture was needed to obtain the desired compaction, a water truck with a spray bar would be driven slowly on the inclined drain followed closely by the self-propelled vibrating roller. See Photos 9, 10, and 11. The material for the filter drain was processed on the jobsite.

(4) Zone 4. Random Material. These materials were mostly granular and compacted as the granular above. Some of the material had silts and clays and had to be compacted with a sheepsfoot roller as described above.

(5) Zones 7 & 8. Rock Material. This consisted of shale with thin interbedded limestone beds and was spread in 8-inch layers and compacted with six passes of the sheepsfoot roller which broke the limestone into small pieces and pulverized the shale. This layer was also compacted with two passes of a 50-ton rubber-tired roller.

SEEPAGE CONTROL

There was a little seepage on the right abutment which caused several slides. Also, some seepage was encountered in the excavation for the drainage gallery.

DIVERSION AND CLOSURE

The inlet and retreat channels were excavated during the 1971 construction season with final completion of the intake channel prior to the diversion of the stream and start of completion of the closure dam on 8 July 1971. No problems were incurred in the diversion of the stream.

2. Site Geology.

a. General. At the damsite, the valley walls stand on moderately steep slopes with shale only a few feet from the surface, as shown on the geologic profile of the dam, Plates 7 and 8. The right abutment slope is steeper than the left. The difference in slopes is due to the westward dip of the rock which dips from the left abutment to the right. The left abutment is 4 horizontal to 1 vertical and the right abutment slope is 3 horizontal to 1 vertical. The bottom lands are divisible into two parts, a flood plain roughly 15 feet above the river and a higher terrace at elevation 680, some 50 feet above the river. The bedrock profile drops off rapidly under the glacial outwash which has a thickness of 160 feet at its deepest point.

Prior to the Illinoian glacial stage, the bedrock valley was cut by preglacial rivers of considerable size. During the Illinoian glacial stage, the valley was partially filled with glacial till and outwash deposits; also, a thin layer of till was deposited on the uplands. Preceding and during the Wisconsin glacial stage, the bulk of the Illinoian deposits were stripped from the valley and uplands. During the advance of the Wisconsin ice sheet, till was deposited on the hills and in the valley. The bulk of the till was in the valley. During a subglacial ice retreat, outwash sands and gravels were deposited on the till in the valley. A thin till, 3 to 15 feet thick, was left on the hilltops. At a later stage in the Wisconsin, the stream was

reentrenched to bedrock on the right bank leaving a 600-foot wide flood plain. It was during this time that the clay till in the valley between elevation 643 and 633 was truncated at Station 21+50. Also at this time, a landslide occurred along the toe of the right abutment. The slide material is highly weathered shale and clay with interbedded limestone which slid from the steep right abutment slope. During the last retreat of the Wisconsin glacier, the entrenched flood plain was filled with outwash sand and gravel. Thick deposits of glacial till (60 feet ±) can be found along tributary streams where the bedrock valley walls protected the till. A good example of this can be found at the toe of the left abutment on the hillside of Highway 101. The clay till, with sand and gravel seams, extends from 500 feet upstream of the centerline of dam to the tributary 1,200 feet downstream from the centerline.

b. Valley Deposits. The 160 feet of valley deposits are essentially outwash sand and gravel with lenses of impervious clay till as shown on the geologic profile of the dam, Plates 7 and 8. Overlying bedrock is 110 feet of pervious sand and gravel with boulder and cobble size glacial erratics. Overlying the pervious sand and gravel is 20 to 30 feet of impervious silty gravelly clay till. The clay till is fairly uniform in thickness beneath the centerline of dam from the left abutment to the present flood plain, Station 21+50±. Top of till varies from elevation 640 to 660. Beneath the flood plain, the clay till has been eroded out by glacial melt waters and replaced by outwash sand and gravel.

c. Bedrock. Bedrock at the damsite consists of Ordovician interbedded calcareous clay shales and hard limestones of the Cincinnati Series. The geologic columnar section, Table 1, D.M. No. 4, was taken from the right abutment.

3. Foundation and Abutment Treatment.

a. Valley. The dam was founded on four different types of foundations. The foundation between Stations 0+00 and 7+50 and Station 27+00 and end of dam consists of lean clay overlying bedrock. The foundation between Stations 0+50 and 21+00 consists of a thin strata of lean clay overlying 10-70 feet of sand and gravel, 35-40 feet of clay till, and up to 60 feet of sand and gravel. Between Station 21+00 and the right abutment, the till had been removed and the embankment was set on sand and gravel for about 200 feet. The remainder of the embankment was set on a variable depth of colluvial material overlain by sand and gravel.

b. Abutments. The abutments have 5 to 15 feet of residual clay overlying bedrock. The left abutment has 10 to 15 feet of residual clay and the right abutment has 5 feet. The top 10 to 20 feet of shale is highly weathered with some thin limestone beds. This highly weathered shale was removed beneath the cutoff trench. A grout curtain was installed to cut off any seepage that might develop through the highly jointed thin limestone beds. A 20-foot center to center single line grout curtain was installed from Station 2+26 to Station 8+25 in the left abutment and Station 26+75 to the right bank of the spillway. The grout curtain is 40 feet deep and was grouted as a single zone. The holes were angled 20 degrees into the abutments and all holes were drilled from the cutoff trench except the spillway holes which were drilled from bottom of excavation. No grout was placed above spillway crest.

4. Embankment.

a. General. Top of dam is elevation 809 and height of dam is approximately 181 feet above streambed. The basic dam section consists

of symmetrical 1 vertical on 3 horizontal exterior slopes with a 30-foot top width. It has an interior upstream impervious sloping core. The core has an interior slope of 1 vertical on 1.5 horizontal and an exterior slope of 1 vertical on 2.2 horizontal. The upstream shell is compacted granular fill and the portion of the dam downstream of the core is compacted random rockfill and compacted granular fill. (See PLATES 14 and 15 for details.) A 100-foot wide upstream berm was constructed at elevation 700 between Stations 21+00 and 23+60. Both upstream and downstream, 200-foot wide berms were constructed at elevation 700 between Stations 23+60 and 25+60. A filter drain was placed on the downstream side of the impervious core. The inclined drain has an 8-foot horizontal thickness and the horizontal drain is 3 feet thick. The top of the drain is elevation 775, Spillway Crest. The downstream slope is protected by a 4-foot thickness of rock from the spillway excavation. Protection against wave wash of the upstream slope was accomplished by a 2-foot thickness of 150 pound maximum size quarry stone between elevation 710 and 809. A 4-foot thickness of rock from the spillway excavation provides protection below elevation 710. Specifications required that the impervious material be compacted by at least six passes over each 6-inch lift with a sheepsfoot roller. The granular materials were compacted by at least four passes over each 6-inch lift with a 50-ton rubber tired roller.

b. Slope Stability. Laboratory testing for the foundation and impervious embankment materials was done by the Ohio River Division Laboratories, Cincinnati, Ohio. Testing of granular material was performed by the South Pacific Division Laboratories, Sausalitio, California. Materials were subjected to shear, consolidation, compaction, permeabilities, and tests associated with classification. A limited number of degradation studies were made on the granular materials. One boring from the spillway area was subjected to shear, wetting and drying, and freeze and thaw tests.

The adopted shear strengths used in the design of the dam are shown in Table 1. Both the arc and block and wedge method of analysis were used for the design. The procedures outlined in Appendix III and IV of EM 1110-2-1902, dated 27 December 1960, were followed for this design. Sections were analyzed at Stations 10+40, 15+00, 23+00, and 25+45 by both methods of design. Tables 2 and 3 list the minimum safety factors for all cases and for both methods of analysis. Stability analysis plates are located in Appendix V, D.M. No. 4. The stability analyses were run with top of dam at elevation 805. Subsequent to the analysis, the top of dam was raised 4 feet to elevation 809. However, the additional height would reduce the factors of safety only slightly, thus the analyses were not rerun. Also, more recent stability criteria would result in using a combined strength envelope for steady seepage, but, it is not considered necessary to reanalyze the dam.

c. Seepage Control. The dam impounds 112 feet of water at water supply pool, elevation 740. This coupled with a deep pervious foundation indicated seepage losses with a possibility of these being dangerous if not controlled. Essentially, control measures consist of blankets, cutoffs, relief drains, and relief wells. A geological profile along the axis of the dam (presented on Plates 7 and 8) indicated a low rock elevation of 518 as found by seismic explorations. Consideration was given to a positive cutoff to rock. At a conference held with ORD and OCE personnel, it was determined that such treatment was not necessary or economically feasible. Studies of seepage characteristics and quantities were made by using the till horizon, where found, to serve as a marker and impervious zone within the pervious materials. It was found that minor amounts of water moved through the deep foundation below the till when compared with the seepage potential of the sand and gravels above the till. An impervious blanket was provided upstream of the dam for a distance of 2,500 feet from the centerline. The blanket is 10 feet thick at the dam and slopes to 5 feet thick at the upstream end.

TABLE NO. 1

ADOPTED SHEAR VALUES

Material	Moist Wt. lbs/ft^3	Sat. Wt. lbs/ft^3	Sub. Wt. lbs/ft^3	Shear Data Type Test	Shear Data Tan Ø	Shear Data C T/SF
Embankment Compacted Impervious Fill	123.0	127.5	65	Q R S	0.000 0.300 0.450	0.90 0.45 0.00
Embankment Compacted Pervious Fill	125.0	127.5	65	Q R S	0.650 0.650 0.650	0.00 0.00 0.00
Foundation Lean Clay	125.0	127.5	65	Q R S	0.100 0.300 0.530	0.90 0.40 0.00
Foundation Glacial Till	--	--	65	Q R S	0.000 0.420 0.550	1.38 0.70 0.00
Foundation Colluvial Clay	--	--	65	Q R S	0.026 0.340 0.300	0.86 0.30 0.00
Foundation Sand & Gravel	--	--	65	Q R S	0.650 0.650 0.650	0.00 0.00 0.00

TABLE NO. 2

SUMMARY OF MINIMUM SAFETY FACTORS
FOR ARC METHOD OF ANALYSIS

	UPSTREAM SLOPE			DOWNSTREAM SLOPE		
Station	After Const.	Draw-down	Partial Pool	Steady Seepage "R"	Steady Seepage "S"	After Const.
10+40	1.42	1.13	1.52 Pool @ El. 713	1.54	1.68	1.27
15+00	1.31	1.41	--	1.75	1.63	--
23+00	1.36	1.20	1.57 Pool @ 713	1.84	1.84	1.87
25+45	1.25	1.20	1.57 Pool @ 713	1.77	1.53	1.27
Berm Slope @ 25+45	1.35	1.39	--	2.00	1.49	1.88

TABLE NO. 3

SUMMARY OF MINIMUM SAFETY FACTORS
FOR BLOCK AND WEDGE METHOD OF ANALYSIS

Station	UPSTREAM SLOPE						DOWNSTREAM SLOPE		
	Through Core			Through Sand and Gravel			Steady Seepage		After Const-ruction
	After Const.	Draw-down	Partial Pool	After Const.	Draw-down	Partial Pool	"R"	"S"	
10+40	1.52	1.47	1.70 Pool @ 713	1.56	1.20	1.75 Pool @740	1.72	1.75	1.56
23+00	1.38	1.61	1.84 Pool @ 713	1.88	1.49	2.07 Pool @ 713	--	--	--
25+45	1.50	2.04	2.16 Pool @713	1.29	1.50	1.73 Pool @ 713	1.95	1.60	1.29
Berm Slope @ 25+45	--	--	--	1.58	--	--	--	1.58	--

A pumping test was made to determine a field value of the overburden permeability to use in underseepage calculations. The test was located on the left bank flood plain near the river as shown on Plate 16. It was concluded that maximum underseepage would occur in this area where there was no natural blanket of near-impervious material. Seventeen piezometers were drilled 10 to 310 feet from a pump well and the piezometers were set to depths indicated on Plate 16. Details of a typical piezometer are shown on Plate 17. All piezometers were set without the use of drilling mud. The holes were kept open by either continuous water circulation or the use of casing which was pulled as gravel packing was poured around the well point and pipe.

Details of the pump well are shown on Plate 17. It was necessary to add four 100-pound sacks of aquagel and one 100-pound sack of lime to the drill water during drilling in order for the hole to remain open. The resulting filter cake was easily flushed from the hole after gravel packing and did not affect the well performance in any way.

The pump well was pumped at a constant rate of 1,170 gpm for 8 hours with a 10-inch stage pump. All piezometers essentially stabilized in 3 hours with very minor adjustments in the last 5 hours of pumping.

The permeability between adjacent piezometers was computed using the indicated formula, which is an adaptation of the Theim Formula. All of the piezometers functioned properly and the individual values agreed closely. The permeability value of 0.240 ft/min. was considered to be an accurate measure of the average horizontal permeability of all material between the water table and the lower impermeable boundary (which is the top of rock in most cases) within the pump test area. The drawdown curve plotted on a semilog on Plate 17 indicated the effective radius of influence to be 900 feet. The underflow was estimated to be about 35 cfs for the flood pool and about 28 cfs for the seasonal pool.

In order to control the seepage, a total of 32 relief wells were intalled along the downstream toe of the dam. A flood pool has not occurred since the impoundment and the maximum underflow at seasonal pool has been 17.5 cfs. Therefore, the estimated underflow was slightly high.

5. Instrumentation. The instrumentation plan consists of settlement plates, movement monuments, and piezometers. The settlement plates measure any settlement that occurs. The movement monuments measure horizontal and vertical movement. The piezometers measure pore pressures.

a. Settlement Plates. Three settlement plates were installed. They are located 20 feet downstream of Stations 12+00, 21+00, and 26+00.

b. Movement Monuments. Three rows of movement monuments were installed. One line is located 400 feet upstream of centerline, one 15 feet downstream, and one 400 feet downstream.

c. Piezometers. A total of 49 piezometers were installed to measure pore pressures. Six piezometers are Casagrande Type, 37 piezometers are gas actuated, and six are Wellpoints.

d. Instrumentation Evaluation.

(1) General. Most of the closed system piezometers initially installed in the dam have become inoperative and, where possible, were recently replaced by Casagrande type piezometers. The following table summarizes the status of the closed system piezometers as of 1 July 1979.

Piezometer Number		Status as of September 1982	
6-1			Replaced
6-2			Replaced
6-3			Replaced
6-4			Replaced
6-5	Broken		
6-6	Broken		
12-1			Replaced
12-2		Operative	
12-3			Replaced
12-4			Replaced
12-5	Broken		
12-6	Broken		
12-7	Broken		
12-8		Operative	
12-9	Broken		
12-10		Operative	
12-11	Broken		
21-1			Replaced
21-2			Replaced
21-3			Replaced
21-4	Broken		
21-6		Operative	
21-7		Operative	
21-8	Broken		
26-1	Broken		
26-2			Replaced
26-3		Operative	
26-4			Replaced
26-5		Operative	

26-6			Replaced
26-7		Operative	
26-8	Broken		
26-9		Operative	
26-10		Operative	
26-11		Operative	
26-12		Operative	

(2) Piezometers.

(a) Station 6+00--The replacement piezometers are the only operative piezometers at this station. These piezometers were recently set and have not stabilized yet.

(b) Station 12+00--The piezometers at this section indicate that controlled seepage is occurring beneath the dam.

(c) Station 21+00--The piezometers at this section also indicate that controlled seepage is occurring beneath the dam.

(d) Station 26+00--The piezometers at this section indicate that the core is effectively reducing the seepage.

(e) Toe Drain Wellpoints--The wellpoint piezometers do not indicate a buildup of pore pressure at the base of the dam. During the Fifth Periodic Inspection, it appeared that the 18-inch BCCMP toe drain was inoperative. Therefore, the adequacy of the toe drain was studied. A weir box was constructed to check the flows from the individual sections of the toe drain. It was determined that the toe drain is working. Nine well points have been added to monitor the dam toe.

(3) Relief Wells. Thirty-two relief wells are located along the toe of the dam to collect underseepage and reduce uplift pressures. The relief wells were last sounded on 14 May 1979. No significant silting of the relief wells has occurred. Measurements of the flows from the undivided relief wells were taken on 15 May 1979. Based on these readings, there is a continuing reduction in seepage beneath the dam. The reduced flow is apparently due to silting of the lake.

(4) Movement Monuments. The readings indicate the embankment has essentially stabilized.

6. Construction Notes. Changes in Embankment Design During Construction.

a. After the contract was awarded, a review of the contract plans ascertained that drainage from the 3-foot horizontal drain in the lower base of the dam was not adequately connected to the toe drainage system. Therefore, it was determined necessary to control the seepage outlet from the horizontal blanket and preclude the development of unsightly wet areas at the downstream base of the embankment. Two 50-foot wide by 2-foot deep inclined connector drains were installed. One was installed between Stations 11+75 and 12+25. The other was installed at Stations 19+50 and 20+00. The design plan for this change is included in Plate No. 15A. This design change was accomplished by Mod. No. 7.

b. The foundation surface between stations about 15+00 to 21+00 after stripping was an irregular surface due to a natural low area. To assure drainage within the 3-foot horizontal drain, some additional stripping and revision of the horizontal drain was necessary as outlined on Plate No. 15B. This design change was accomplished by Mod. No. P00015.

c. A major portion of the dam embankment overlies glacial outwash sands and gravels. The outwash sands and gravels were adequate to support the load of the embankment. However, the design called for downstream relief wells and an upstream impervious blanket to control the underseepage through the sands and gravels. After stripping the upstream blanket area, the plans called for excavating the area of glacial outwash material down to elevation 637 or clay (glacial till). This material consisted of SP, SM, and SC materials and it was planned to use these materials in the granular zone of the dam embankment. However, the specifications for the granular zone specified that the granular zone material should not have more than 10 percent by weight passing the Standard No. 200 sieve. As the excavation progressed, it was found that the contact with the underlying till was an irregular surface and the materials were layered and when picked up by scrapers, contamination and segregation occurred to the extent that the material would not meet the gradation requirements of the granular zone. To prevent wasting of this random material, it was determined to be in the best interest of the Government to rezone the embankment in order to use this material as random fill. This rezoned area was located below elevation 740 between Stations 8+25 and 23+00 and extended from centerline upstream to the inclined drain. This change is depicted on Plate Number 14. This change was accomplished by Modification No. P0001.

d. As work progressed, it became evident that the previously designated area of rezoning from granular zone to random zone was not large enough to accommodate the amount of materials being excavated from beneath the upstream blanket area. Again an area between Stations 8+25 and 23+00 and extending from centerline to 100 feet downstream below elevation 740 of the embankment was rezoned from granular to random fill to accommodate the use of this material. This change was accomplished by Modification P00032. This change is depicted on Plate Number 14.

e. In order to reduce the risk of overtopping of the existing embankment in the closure section of the embankment, the contract specified that the embankment should be constructed to elevation 717 prior to the end of the 1972 construction season. Prior to the month of November 1972, the Contractor was progressing on the embankment placement at a rate which left little doubt that the 717 elevation would be attained. However, due to causes beyond the control of the Contractor, specifically unfavorable weather conditions during November, it became apparent that the embankment would not reach elevation 717. In order to provide the needed protection, the Contractor was directed to construct a temporary dike to elevation 717 across the closure section of the embankment. The portion of the material placed over the inclined drain and impervious zones was reexcavated at the beginning of next construction season. This area of the embankment was the only area in which rock type material (shale) was placed against the inclined drain. In the process of cutting the inclined slope within this shale embankment, it was difficult to maintain a uniform slope in the compacted shale fill for the incline drain to be placed and compacted against. After this, in areas where the plans allowed for placement of random rock materials next to the inclined drain, granular clay type random materials were used for at least one scraper to facilitate overbuilding of the design line and recutting to the line to form a face of compacted random material to place the incline drain against. A typical section of this temporary dike embankment design is shown on Plate No. 15C.

f. The specifications called for a towed vibratory roller with a width between 5.5 and 6.5 feet to compact an 8-foot wide inclined filter zone. As work progressed, problems were encountered in obtaining the required compaction with the specified towed vibratory roller. Essen-

tially, two problems were encountered with the towed vibratory roller. One was in obtaining of the required compaction close to the face of the next zone with a vibratory roller which was towed with a tractor with a track width wider than the roller. Also, if the filter drain material was not leveled off after placement and prior to compaction at a close tolerance, the machine tended to migrate to one side or the other. To overcome these problems, the Contractor was directed to provide a self-propelled roller which could be controlled better and which eliminated the problems in obtaining the required compaction. The Contractor provided a Ferguson SP 75B roller for this purpose. This change was accomplished by Modification No. P00042.

g. As the embankment placement progressed, it was determined that an error in the calculated yield of shale from the spillway excavation had been made. This necessitated another rezoning of the embankment. The random zone above elevation 740 was rezoned from compacted random fill to compacted random rockfill. Also, a 30-foot width zone of random fill to be placed above elevation 710 on the downstream slope and beneath the 4-foot width of compacted earth was designated. This was accomplished by Modification No. 47 and is shown on Contract Drawing EFW-2.2-12.3/19 Rev. No. 3.

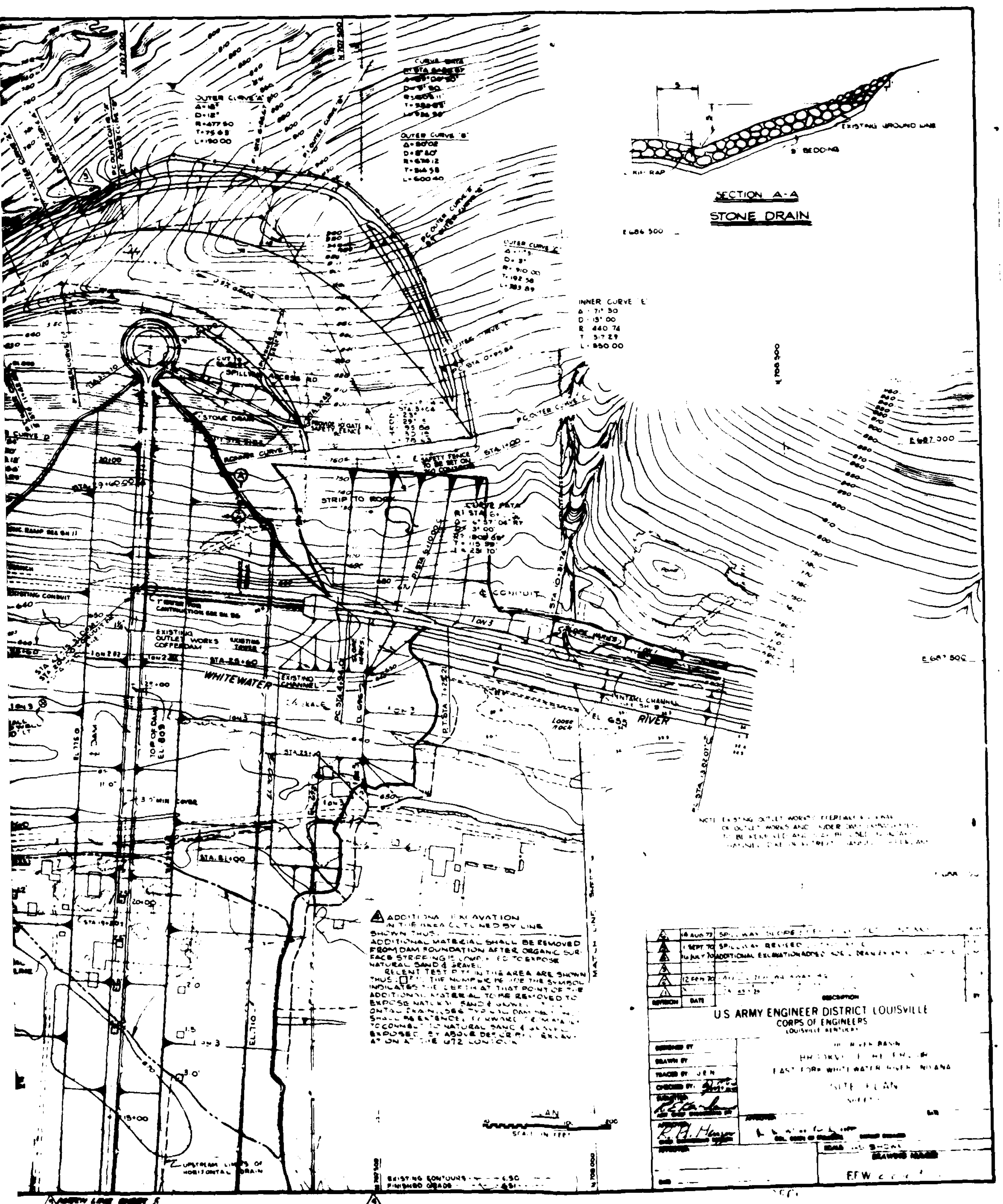
Modifications List See Foundation Report

Construction Equipment. The equipment listed below was in use June 1972.

4 Caterpillar 666 scrapers
4 Caterpillar 647 scrapers
1 Shovel Supply Co. self-propelled vibrating roller
2 Ferguson self-propelled vibrating roller
2 Ferguson self-propelled sheepsfoot roller

1 50T Tampo Caterpiller self-propelled (pneumatic) roller
1 50T Laplant Choate self-propelled (pneumatic) roller
6 Caterpillar D-8 dozers
3 Caterpillar D-9 dozers
1 Caterpillar Traxcavator
2 Caterpillar 16 Graders
1 A-C M-100 grader
1 American 5299 crane
1 Manitowoc 3900 crane
1 Bantam T-350 crane
1 Rome HD plow
1 Caterpillar water wagon
1 Kelly ripper
4 Caterpillar light plants
4 Jaeger pumps 6-inch
3 Dump trucks
1 Ingersoll-Rand compressor
2 Lincoln welders

CORPS OF ENGINEERS

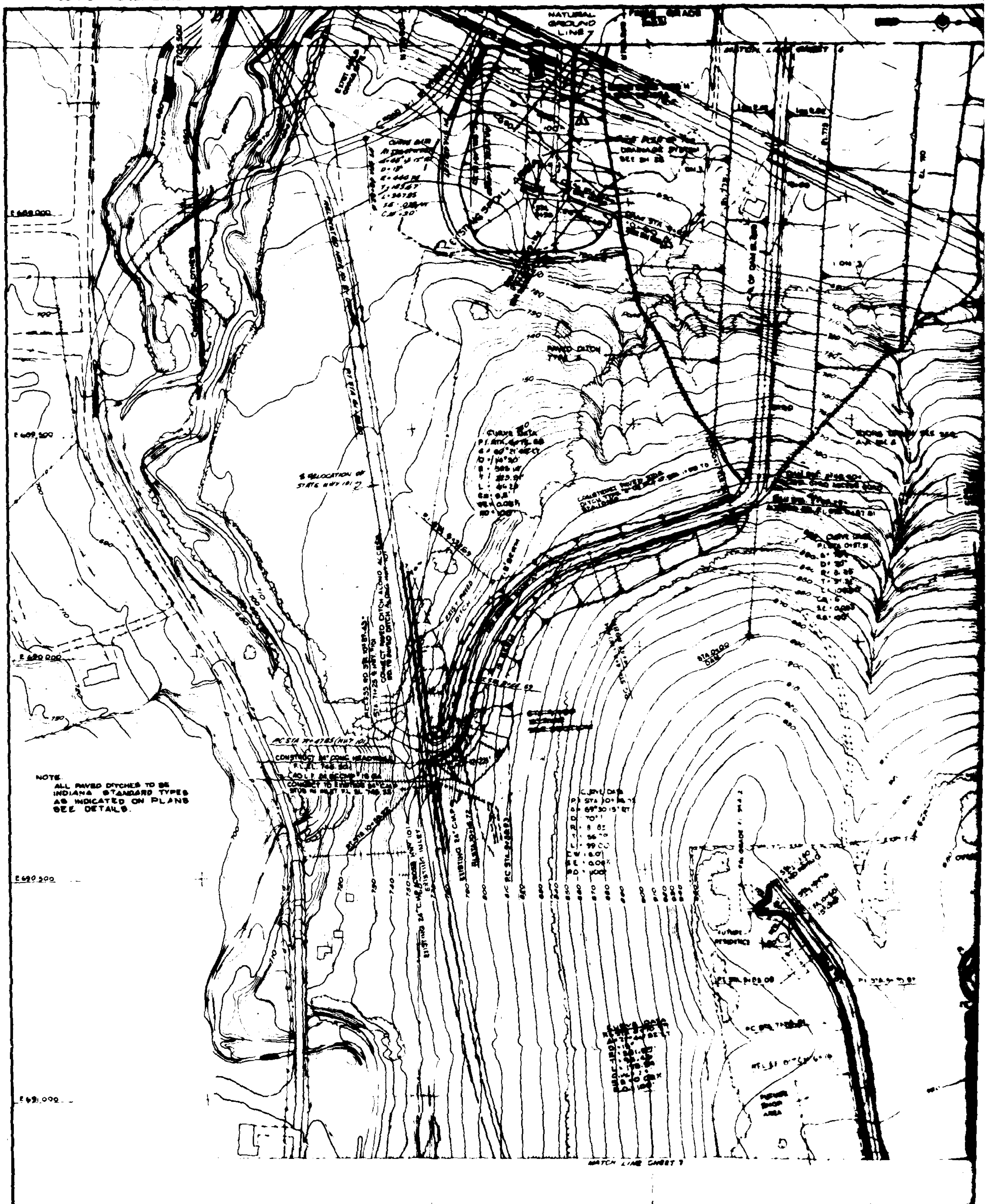


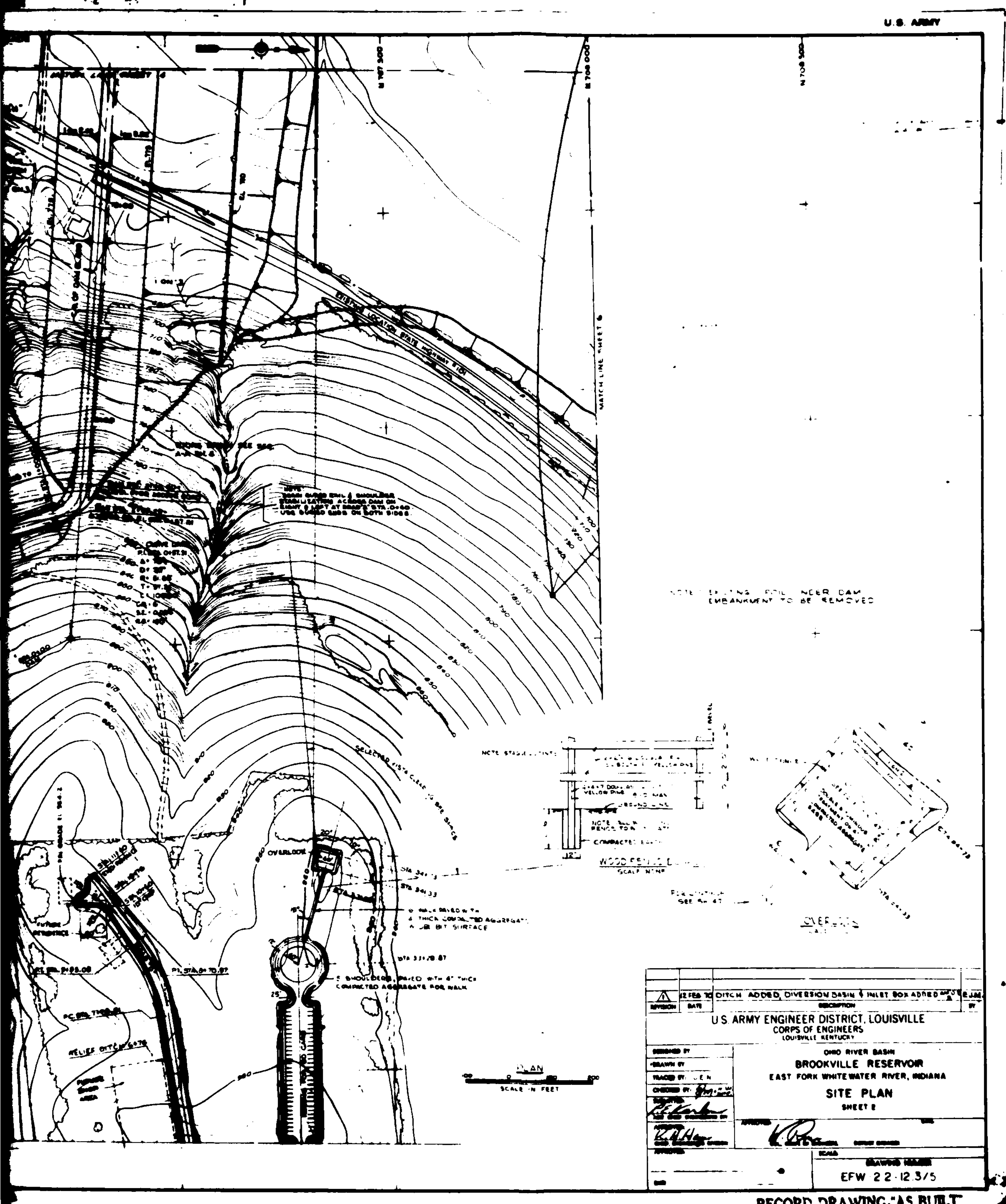
SECTION A-A
STONE DRAIN
EXISTING GROUND LINE
BEDDING
RIP RAP
OUTER CURVE 'A'
OUTER CURVE 'B'
OUTER CURVE 'C'
INNER CURVE 'E'
Δ = 71° 30
D = 13° 00
R = 440.74
T = 317.29
L = 550.00
E 686 500
E 687 000
E 687 500
N 708 000
STRIP TO ROCK
CURVE DATA
SPILLWAY ACCESS RD
STONE DRAIN
℄ CONDUIT
EXISTING CONDUIT
EXISTING OUTLET WORKS COFFERDAM
EXISTING TOWER
STA 25+60
WHITEWATER
EXISTING CHANNEL
RIVER
EL 655
INTAKE CHANNEL
Loose Rock
STA 81+00
3.0' MIN COVER
TOP OF DAM EL 809
EL 710
MATCH LINE
ADDITIONAL EXCAVATION IN THE AREA OUTLINED BY LINE SHOWN THUS
ADDITIONAL MATERIAL SHALL BE REMOVED FROM DAM FOUNDATION AFTER ORGANIC SURFACE STRIPPING IS COMPLETED TO EXPOSE NATURAL SAND & GRAVEL.
UPSTREAM LIMITS OF HORIZONTAL DRAIN
EXISTING CONTOURS
FINISHED GRADE
SCALE IN FEET
MATCH LINE SHEET 5
U.S. ARMY ENGINEER DISTRICT LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY
EAST FORK WHITEWATER RIVER, INDIANA
SITE PLAN
DESIGNED BY
DRAWN BY
TRACED BY
CHECKED BY
REVISION
DATE
DESCRIPTION
SCALE AS SHOWN
DRAWING NUMBER

PLATE NO. 1

2

CORPS OF ENGINEERS

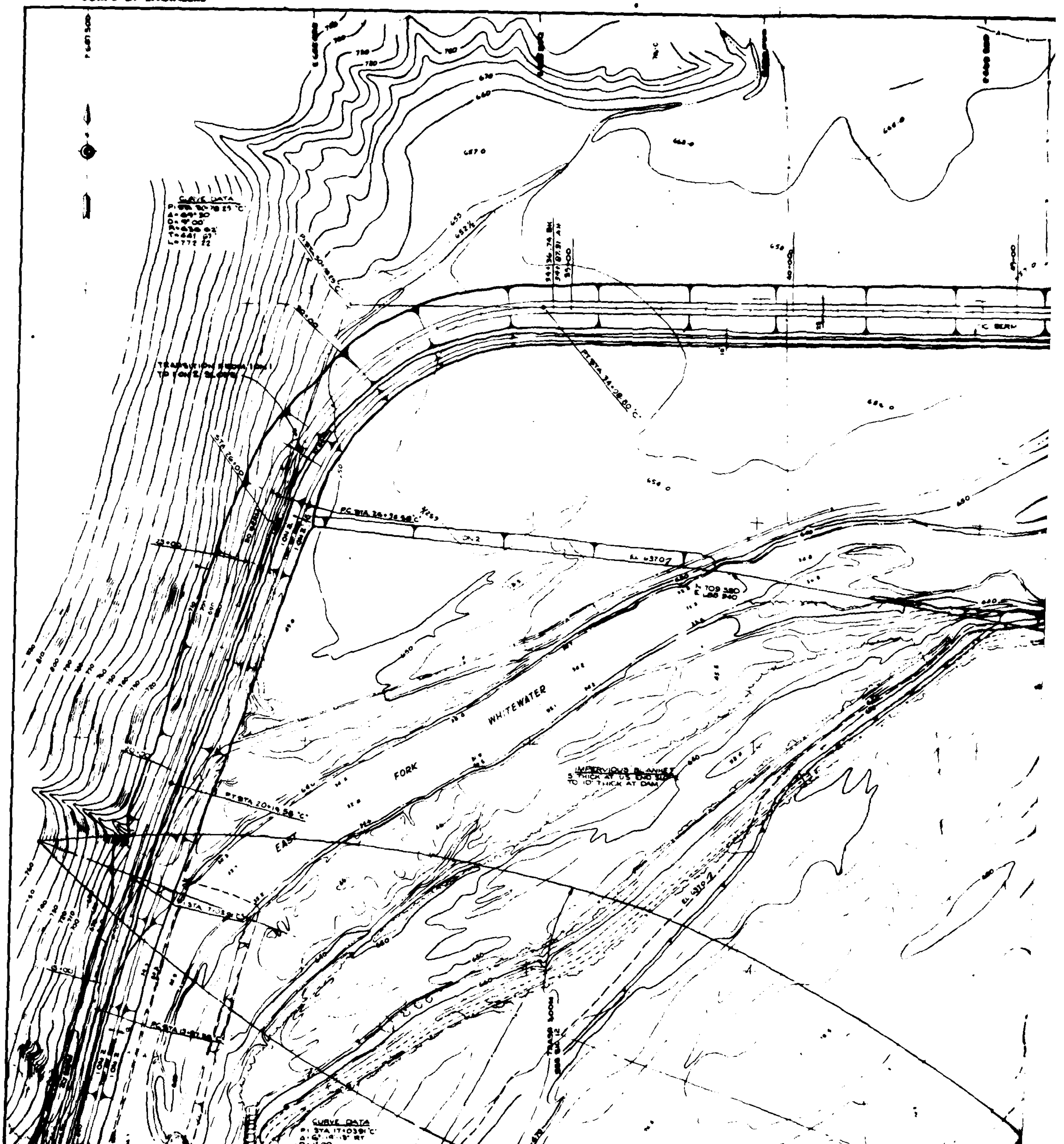


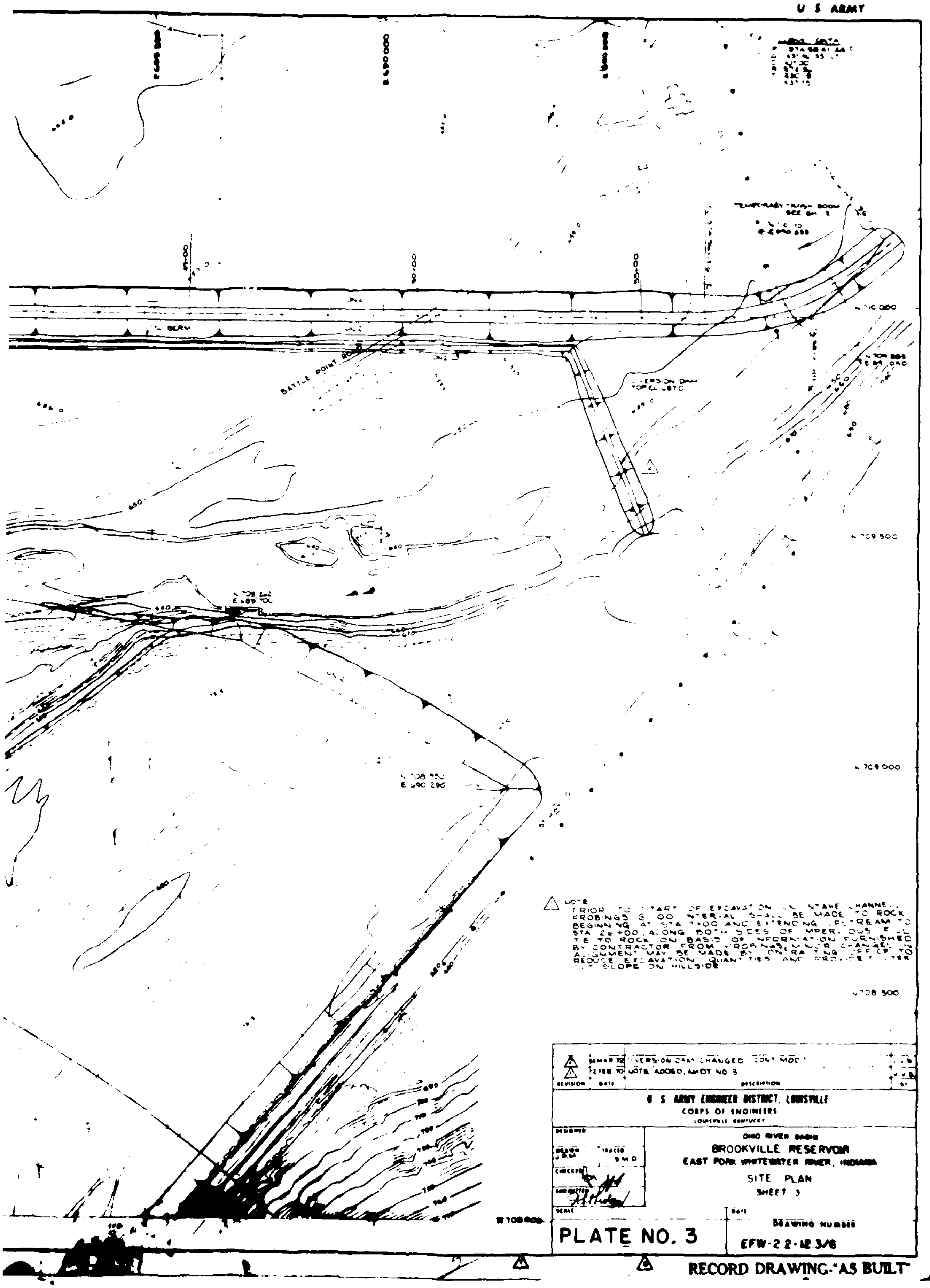


RECORD DRAWING "AS BUILT"

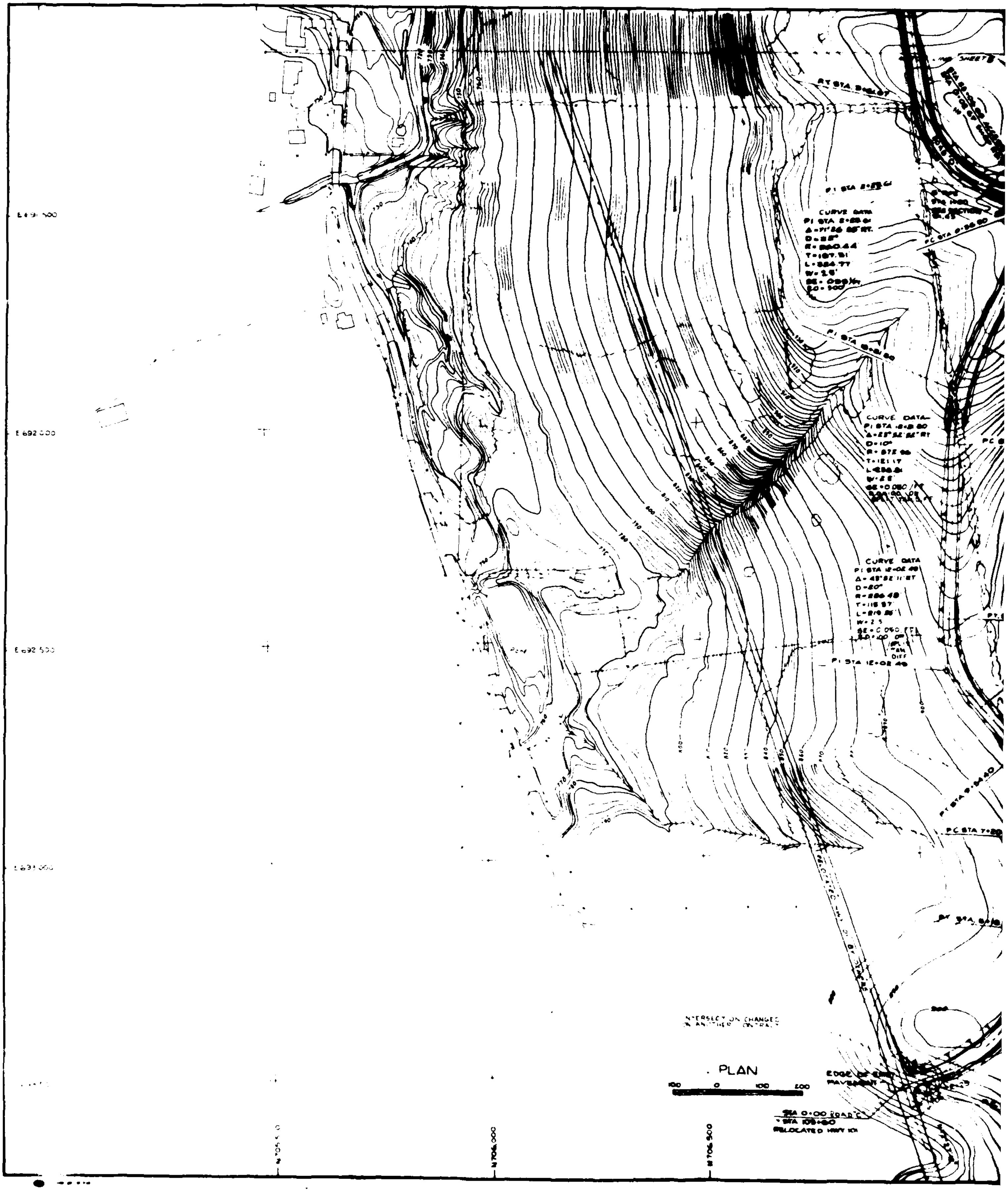
PLATE NO. 2

CORPS OF ENGINEERS

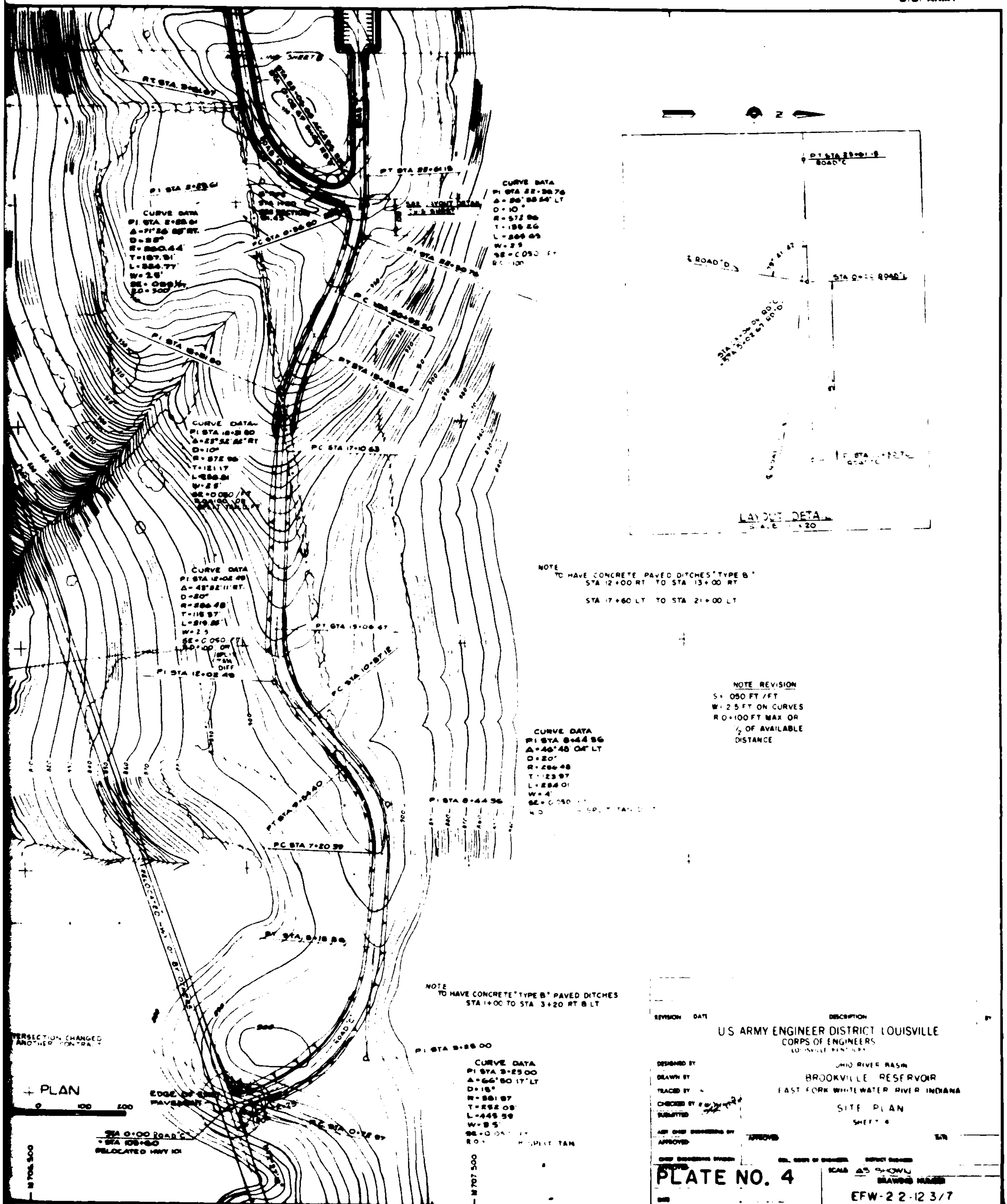



U S ARMY
BATTLE POINT ROAD
BERM
N 709 500
N 709 000
N 708 850
E 690 290
N 708 500
NOTE
BY CONTRACTOR FROM
SLOPE ON HILLSIDE
NOTE ADDED, AMDT NO 3
REVISION
DATE
DESCRIPTION
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
DESIGNED
DRAWN
TRACED
CHECKED
SCALE
BROOKVILLE RESERVOIR
SITE PLAN
SHEET 3
DRAWING NUMBER
PLATE NO. 3
EFW-2 2-12.3/6
RECORD DRAWING-"AS BUILT"

CORPS OF ENGINEERS



U.S. ARMY



NOTE
TO HAVE CONCRETE PAVED DITCHES "TYPE B"
STA 12+00 RT TO STA 13+00 RT
STA 17+60 LT TO STA 21+00 LT

NOTE REVISION
S= .050 FT/FT
W= 2.5 FT ON CURVES
R.O.=100 FT MAX OR ½ OF AVAILABLE DISTANCE

NOTE
TO HAVE CONCRETE "TYPE B" PAVED DITCHES
STA 1+00 TO STA 3+20 RT & LT

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

DESIGNED BY
DRAWN BY
TRACED BY
CHECKED BY
SUBMITTED
APPROVED

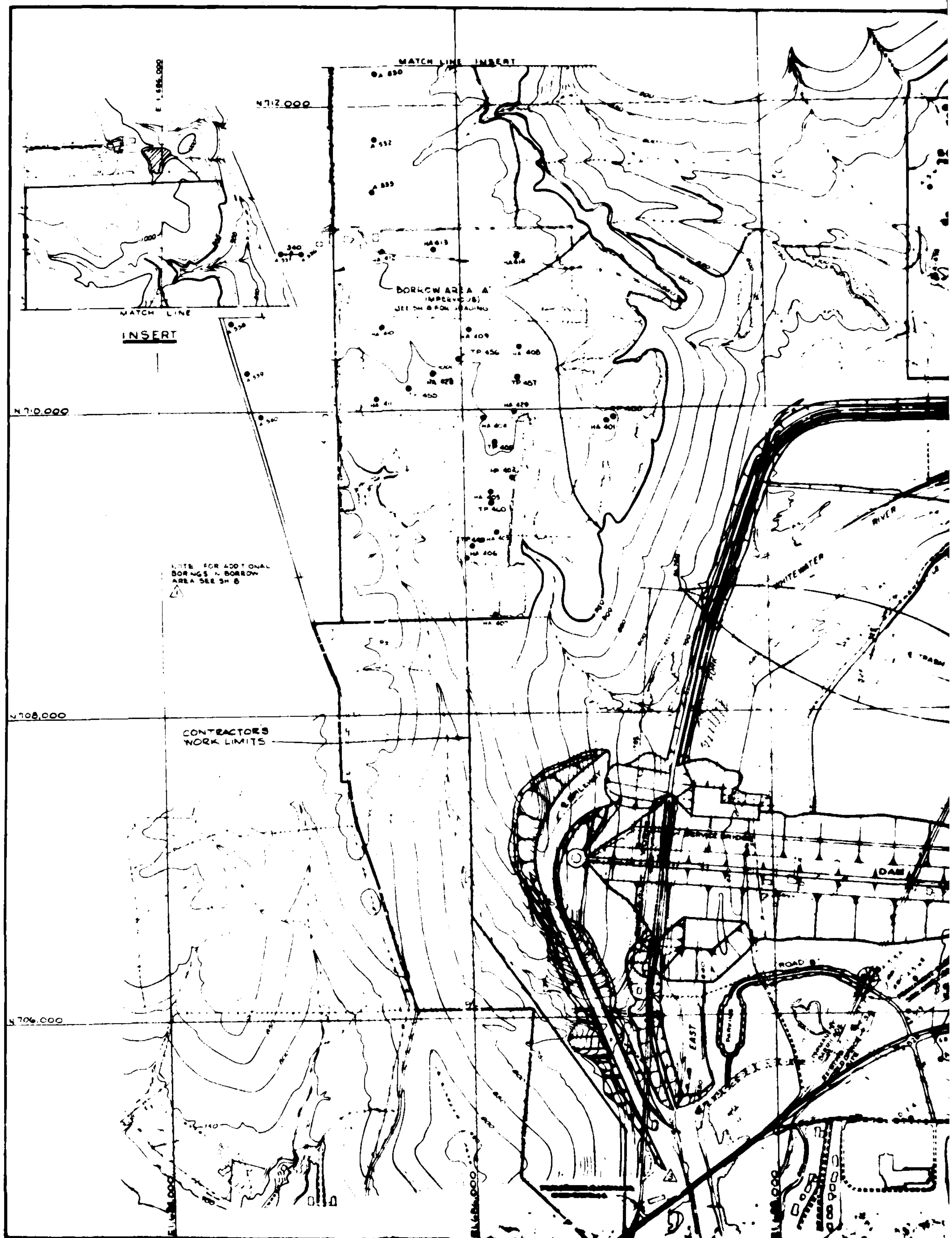
OHIO RIVER BASIN
BROOKVILLE RESERVOIR
EAST FORK WHITEWATER RIVER, INDIANA
SITE PLAN
SHEET 4

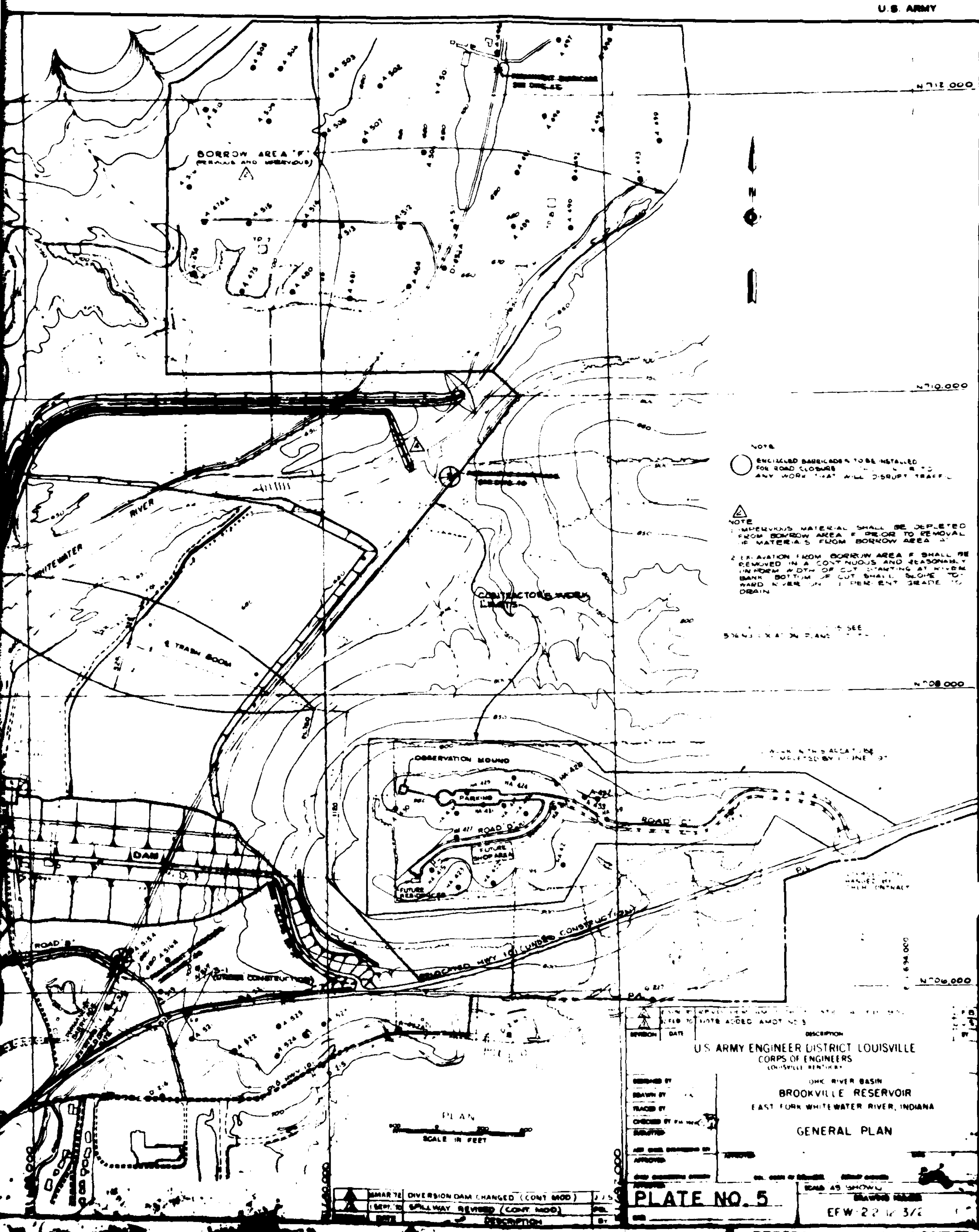
SCALE AS SHOWN
DRAWING NUMBER
EFW-22-12 3/7

PLATE NO. 4

RECORD DRAWING "AS BUILT"

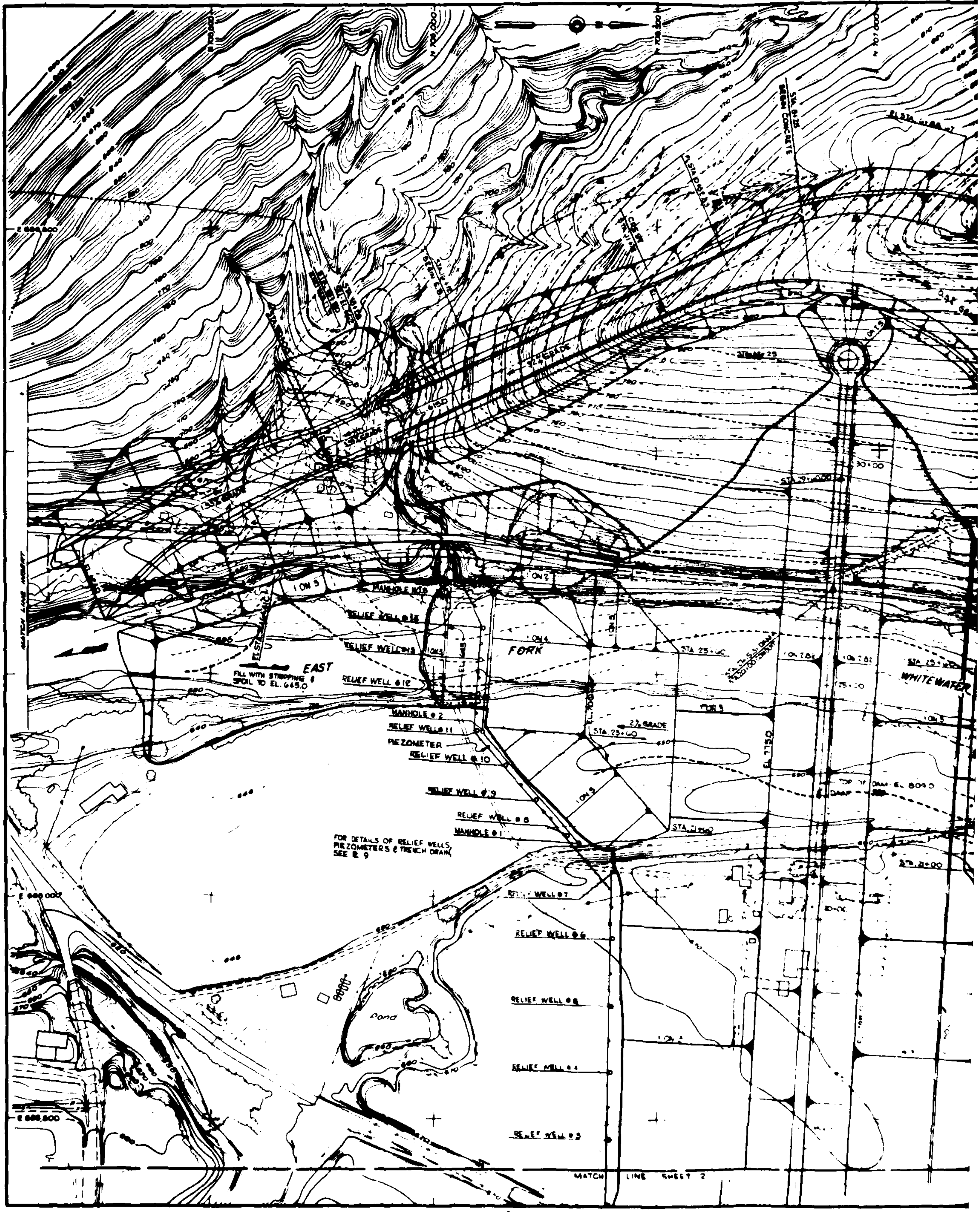
1 2

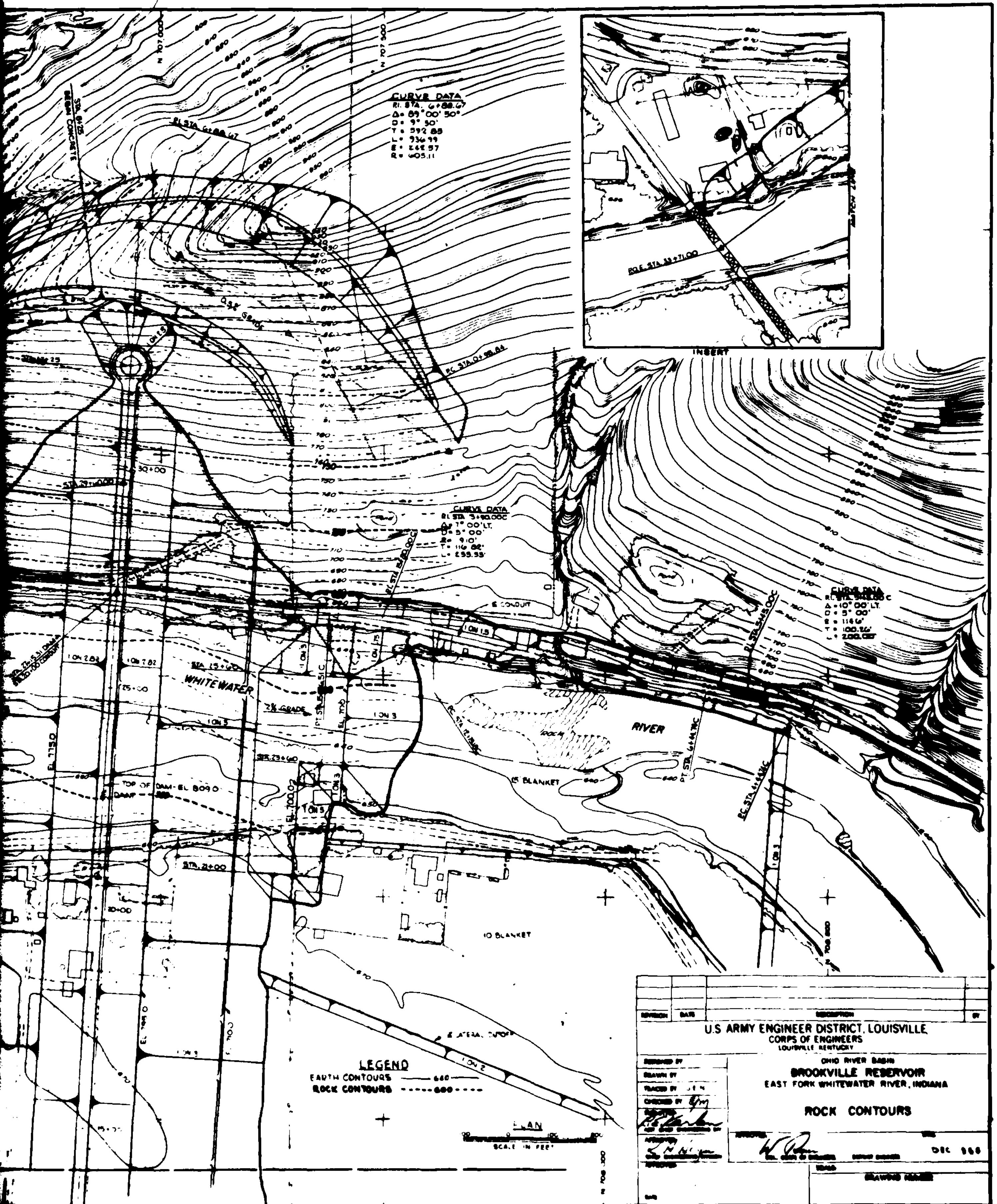

MATCH LINE INSERT
N 712,000
E 1,586,000
MATCH LINE
INSERT
BORROW AREA "A"
(IMPERVIOUS)
SEE SH 8 FOR GRADING
N 710,000
NOTE: FOR ADDITIONAL BORINGS IN BORROW AREA SEE SH 8
N 708,000
CONTRACTOR'S WORK LIMITS
WHITEWATER
RIVER
DAM
ROAD
EAST
N 706,000



U.S. ARMY
BORROW AREA "F"
WHITEWATER RIVER
TRASH BOOM
CONTRACTOR'S WORK LIMITS
OBSERVATION MOUND
PARKING
FUTURE SHOP AREA
FUTURE RESIDENCES
DAM
ROAD "B"
NOTE
ENCIRCLED BARRICADES TO BE INSTALLED FOR ROAD CLOSURE
ANY WORK THAT WILL DISRUPT TRAFFIC
NOTE
IMPERVIOUS MATERIAL SHALL BE DEPLETED FROM BORROW AREA F PRIOR TO REMOVAL OF MATERIALS FROM BORROW AREA
2 EXCAVATION FROM BORROW AREA F SHALL BE REMOVED IN A CONTINUOUS AND REASONABLY UNIFORM WIDTH OF CUT STARTING AT RIVER BANK BOTTOM OF CUT SHALL SLOPE TOWARD RIVER ON PERCENT GRADE TO DRAIN
N 712,000
N 710,000
N 708,000
N 706,000
PLAN
SCALE IN FEET
DIVERSION DAM CHANGED (CONT MOD)
SPILLWAY REVISED (CONT MOD)
DESCRIPTION
NOTE ADDED AMDT NO 3
REVISION
DATE
U.S. ARMY ENGINEER DISTRICT LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE KENTUCKY
OHIO RIVER BASIN
BROOKVILLE RESERVOIR
EAST FORK WHITEWATER RIVER, INDIANA
GENERAL PLAN
PLATE NO. 5
SCALE AS SHOWN
EFW-22/12 3/2
RECORD DRAWING AS BUILT

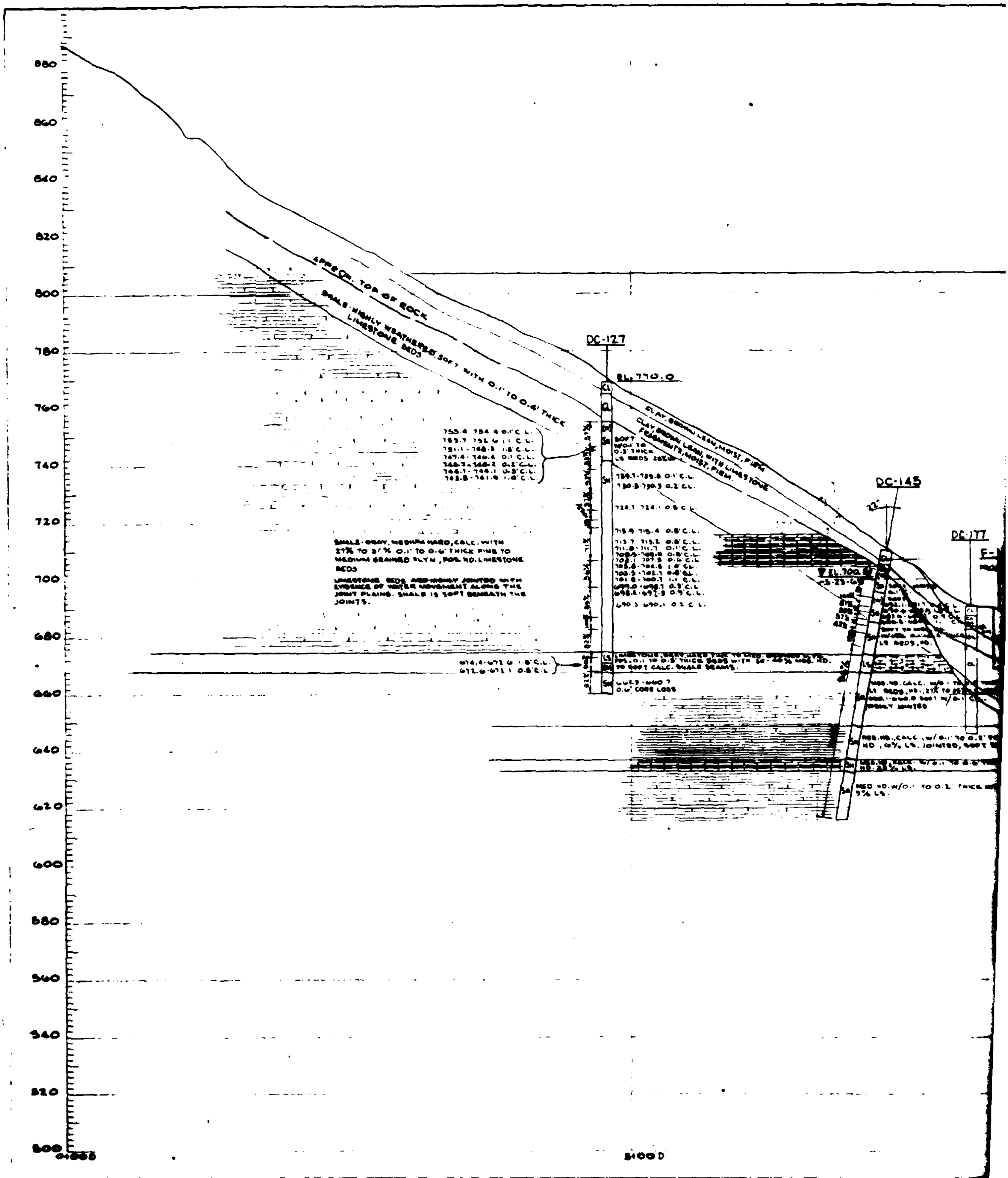
CORPS OF ENGINEERS



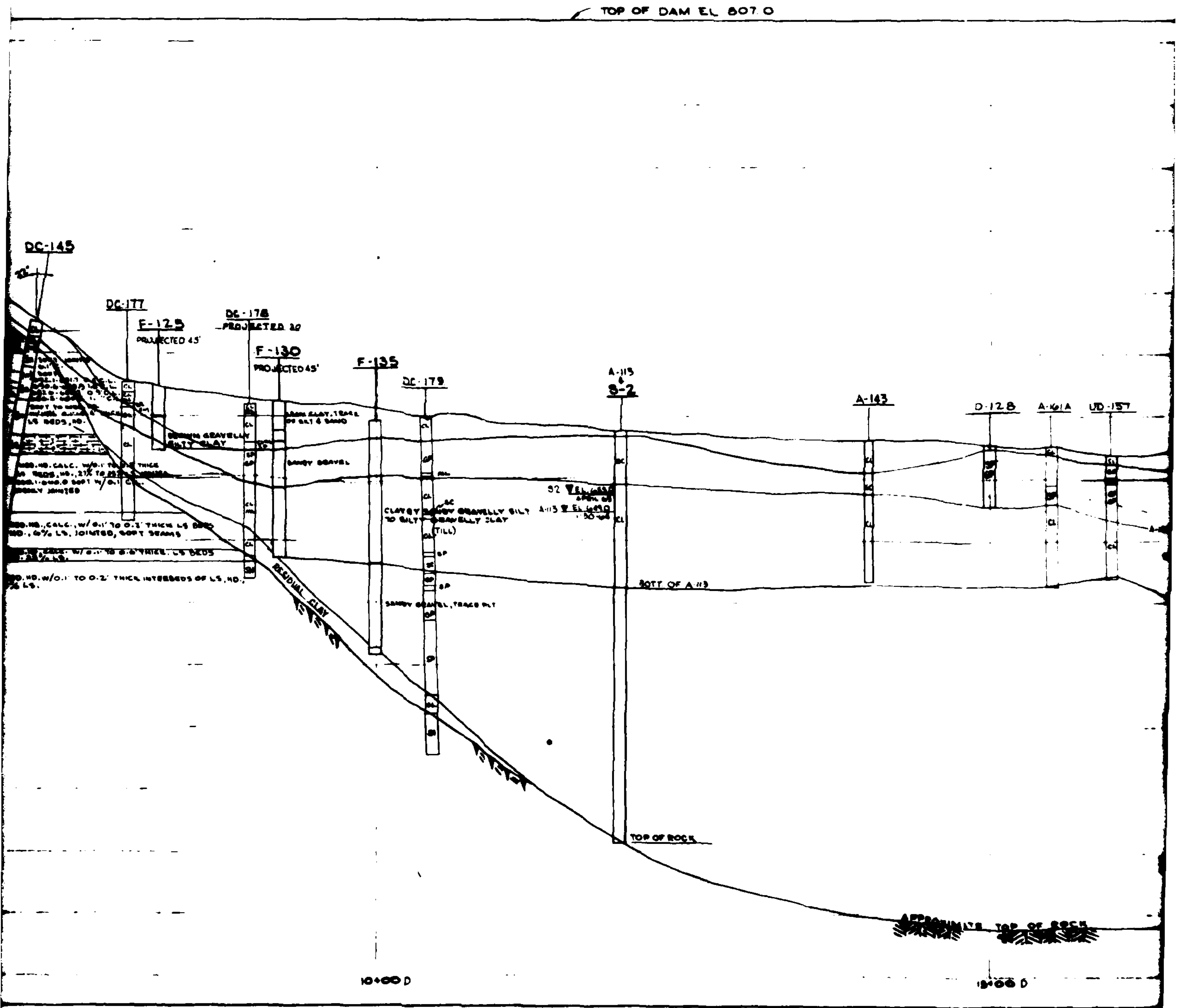


4 TH IND. DM No 4

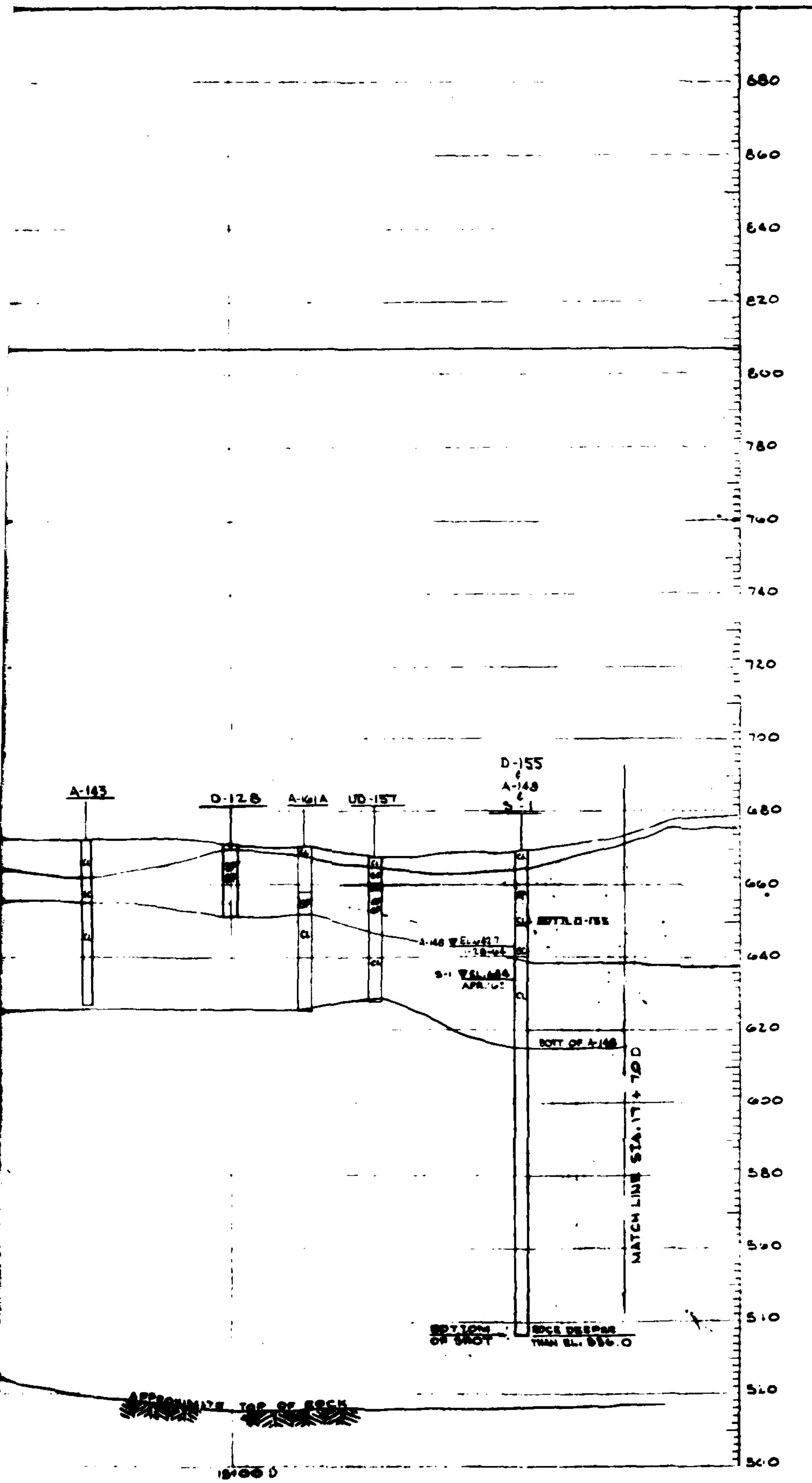
PLATE NO. 6



880
860
840
820
800
780
760
740
720
700
680
660
640
620
600
580
560
540
520
500
APPROX. TOP OF ROCK
DC-127
EL. 770.0
DC-145
DC-177
CLAY, BROWN, LEAN, MOIST, FIRM


TOP OF DAM EL 807.0
DC-145
DC-177
F-125
PROJECTED 45'
DC-178
PROJECTED 30
F-130
PROJECTED 45'
F-135
DC-179
A-115
S-2
A-143
D-128
A-161A
UD-157
BROWN GRAVELLY SILTY CLAY
SANDY GRAVEL
CLAYEY SANDY GRAVELLY SILT TO SILTY GRAVELLY CLAY
(TILL)
SANDY GRAVEL, TRACE SILT
RESIDUAL CLAY
BOTT OF A-113
TOP OF ROCK
APPROXIMATE TOP OF ROCK
10+00 D
15+00 D

2



REV. 11-10-64

OHIO RIVER BASIN

BROOKVILLE RESERVOIR

EAST FORK WHITEWATER RIVER, INDIANA

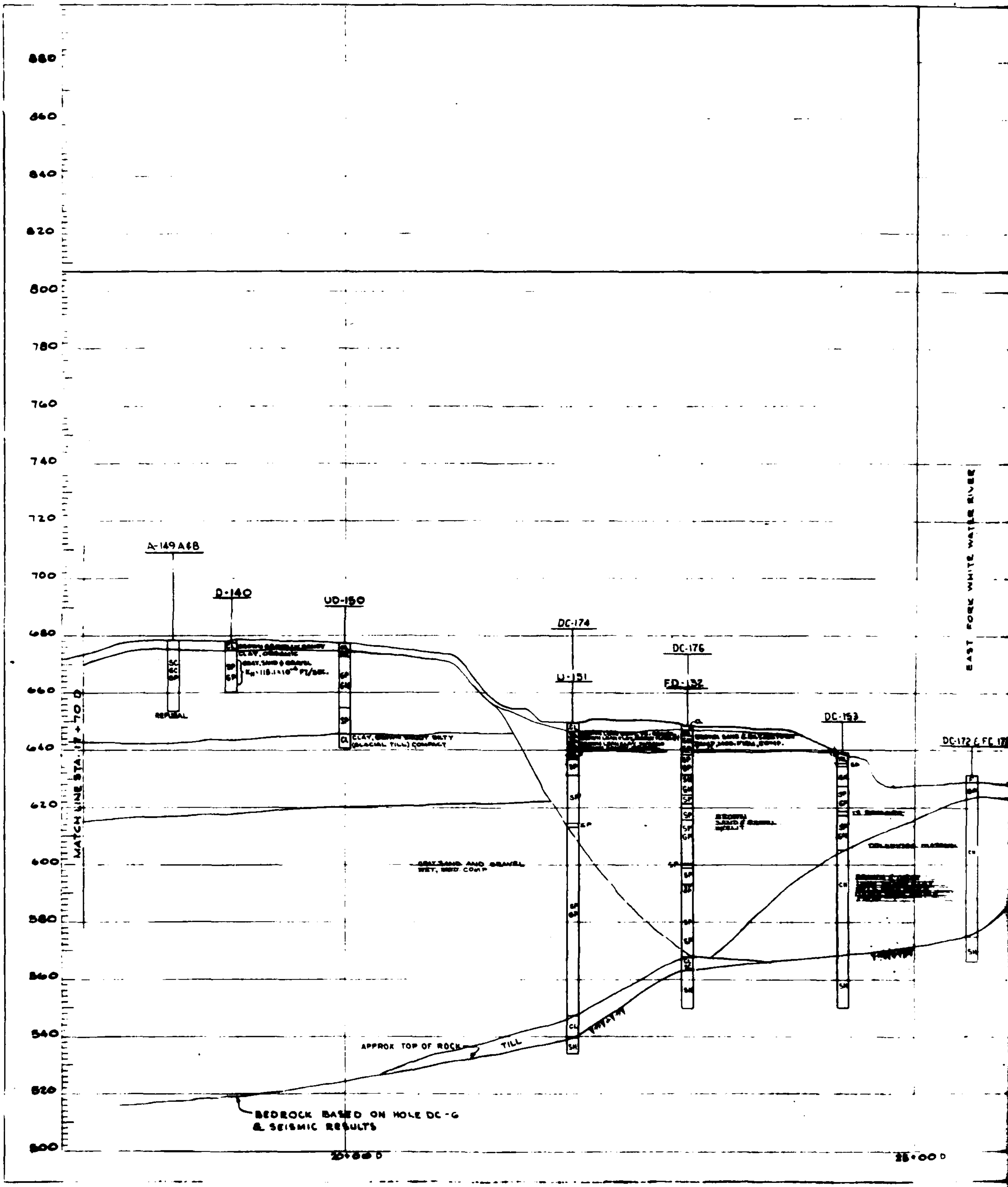
GEOLOGIC PROFILE OF DAM

SHEET NO. 1

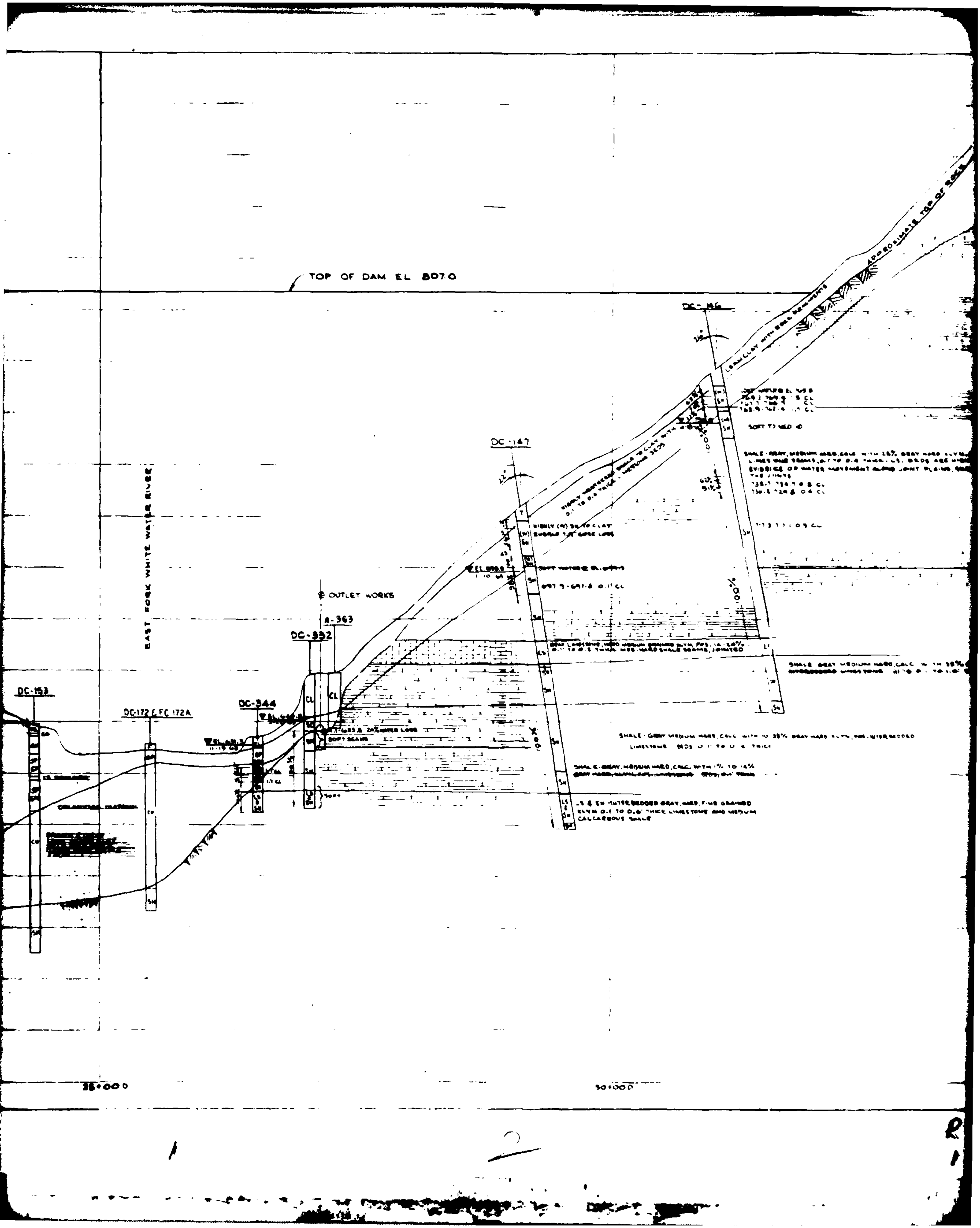
DM. NO 4

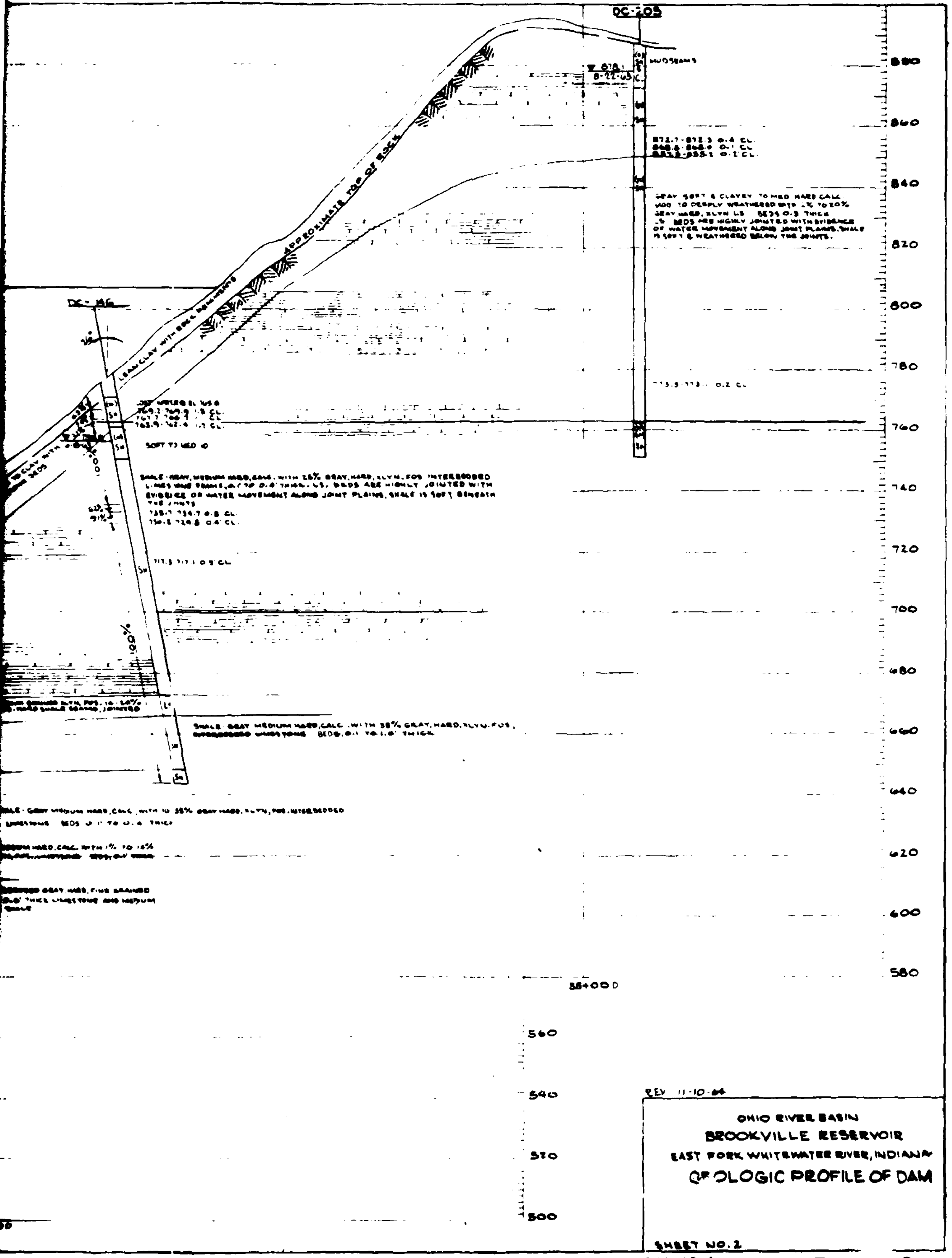
PLATE NO. 7

3



880
860
840
820
800
780
760
740
720
700
680
660
640
620
600
580
560
540
520
500
MATCH LINE STA. 17+70 D
A-149 A&B
D-140
UD-150
DC-174
DC-176
U-151
FD-132
DC-153
DC-172 & FC-17
EAST FORK WHITE WATER RIVER
CLAY, ORGANIC
CLAY, BROWN SANDY SILTY (GLACIAL TILL) COMPACT
GRAY SAND AND GRAVEL WET, MED COMP
BROWN SAND & GRAVEL MOIST
APPROX TOP OF ROCK
TILL
BEDROCK BASED ON HOLE DC-6 & SEISMIC RESULTS
20+00 D
25+00 D


TOP OF DAM EL 807.0
APPROXIMATE TOP OF ROCK
DC-146
DC-147
EAST FORK WHITE WATER RIVER
℄ OUTLET WORKS
A-363
DC-332
DC-153
DC-172 & FC 172A
DC-344
50+000



REV 11-10-64

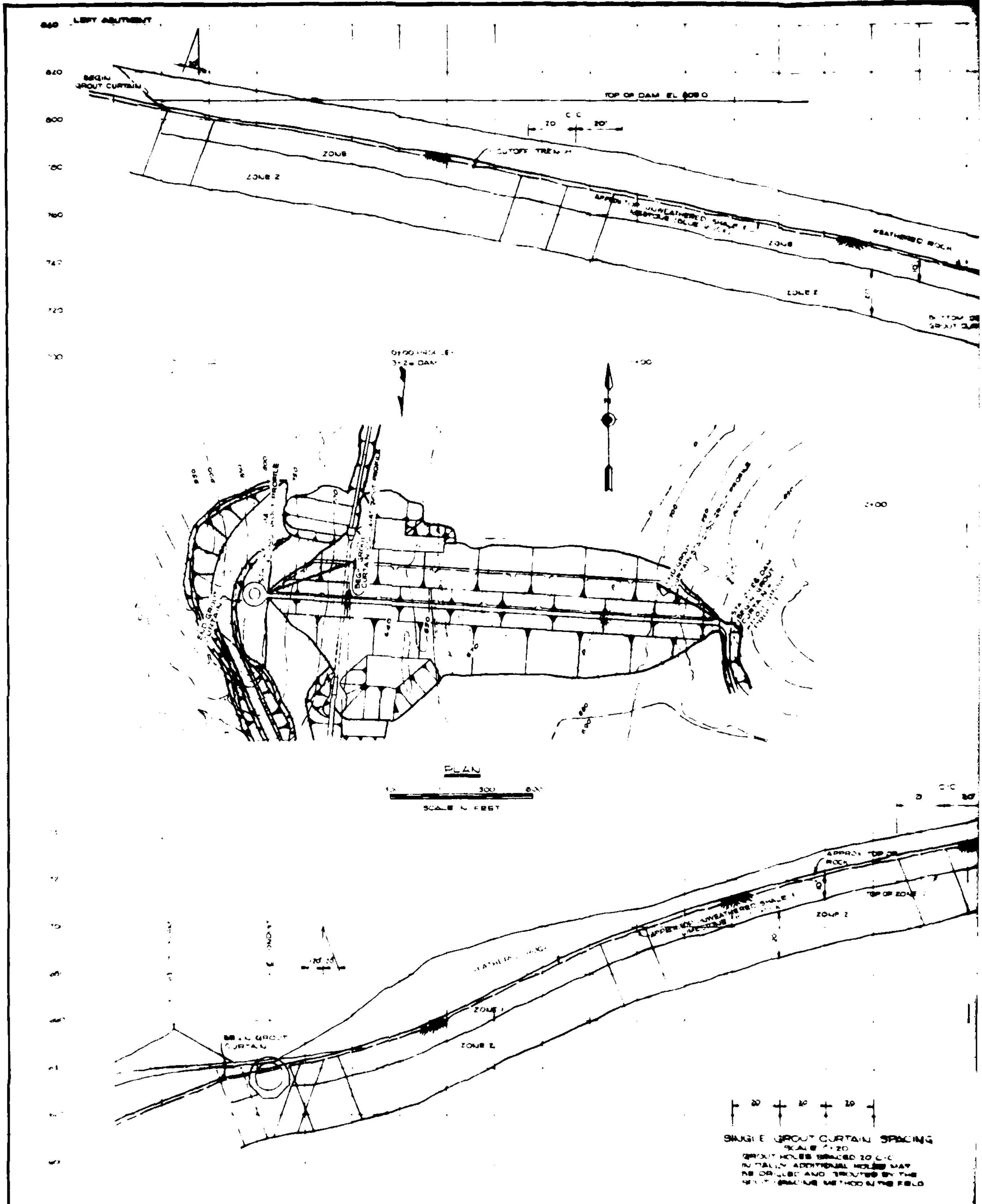
OHIO RIVER BASIN
BROOKVILLE RESERVOIR
EAST FORK WHITEWATER RIVER, INDIANA
GEOLOGIC PROFILE OF DAM

SHEET NO. 2

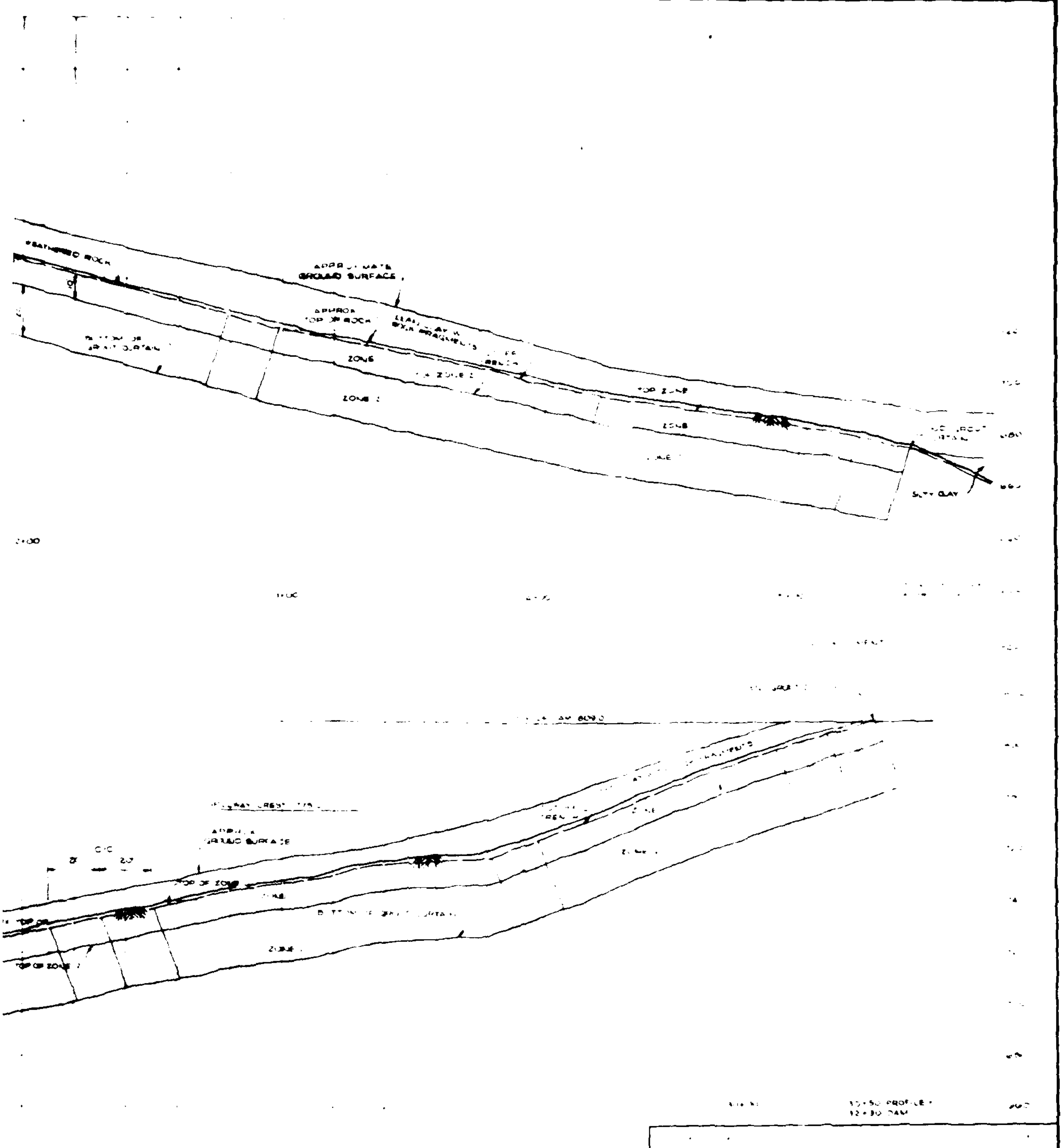
D.M NO. 4

PLATE NO. 8

CORPS OF ENGINEERS



U. S. ARMY



IN SPACING

2. MAXIMUM GROUT PRESSURE ... AT HEAD OF GROUT PIPE.

REVISION	DATE	DESCRIPTION	BY

U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

OHIO RIVER BASIN
BROOKVILLE RESERVOIR
EAST FORK WHITEWATER RIVER, INDIANA
DAM
GROUTING PLAN AND PROFILE

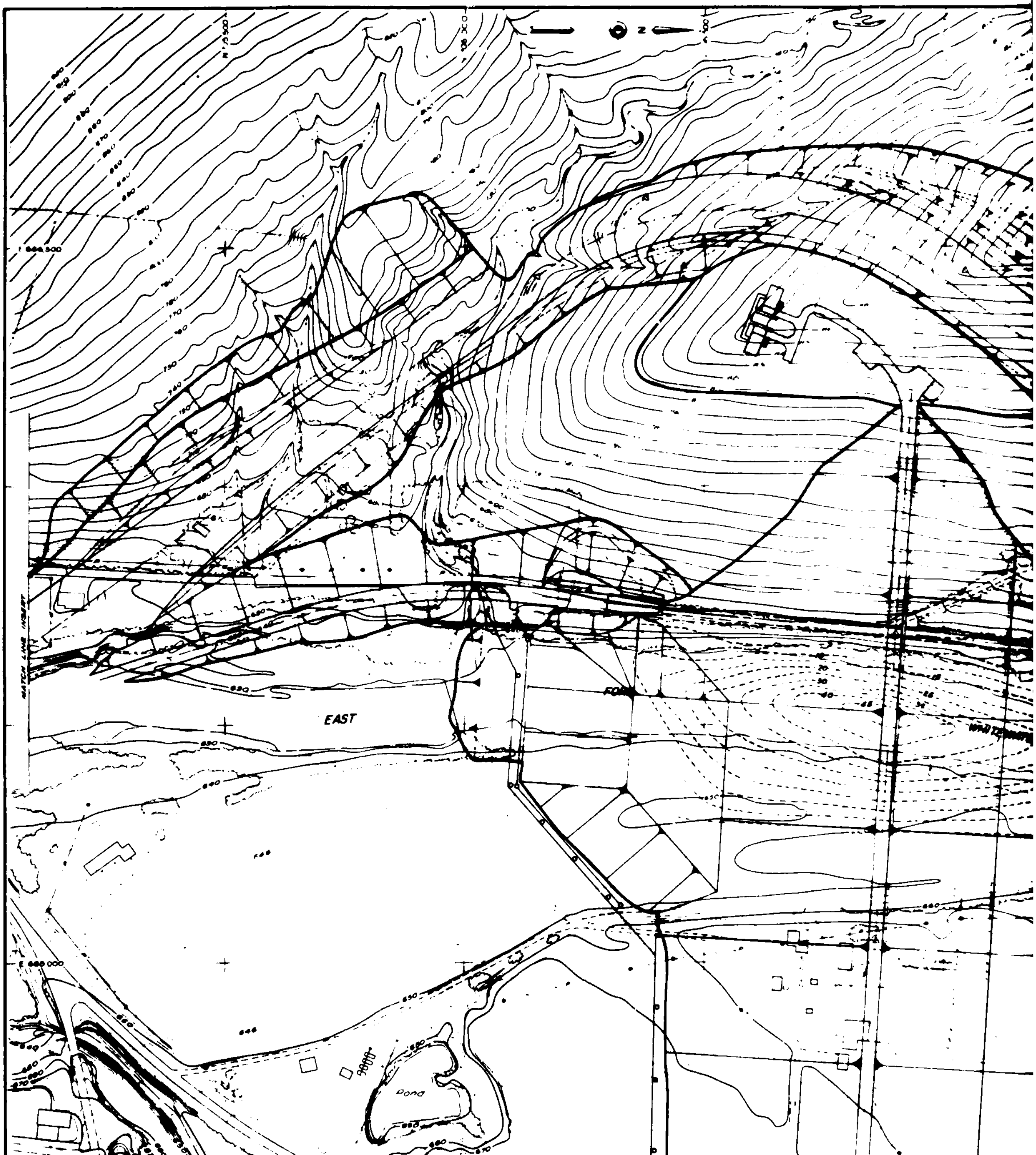
DESIGNED
DRAWN
TRACED JWN
CHECKED
SUBMITTED
APPROVAL RECOMMENDED
APPROVED
SCALE

PLATE NO. 9

DRAWING NUMBER
EFW-22-123/24

RECORD DRAWING AS BUILT

2



1

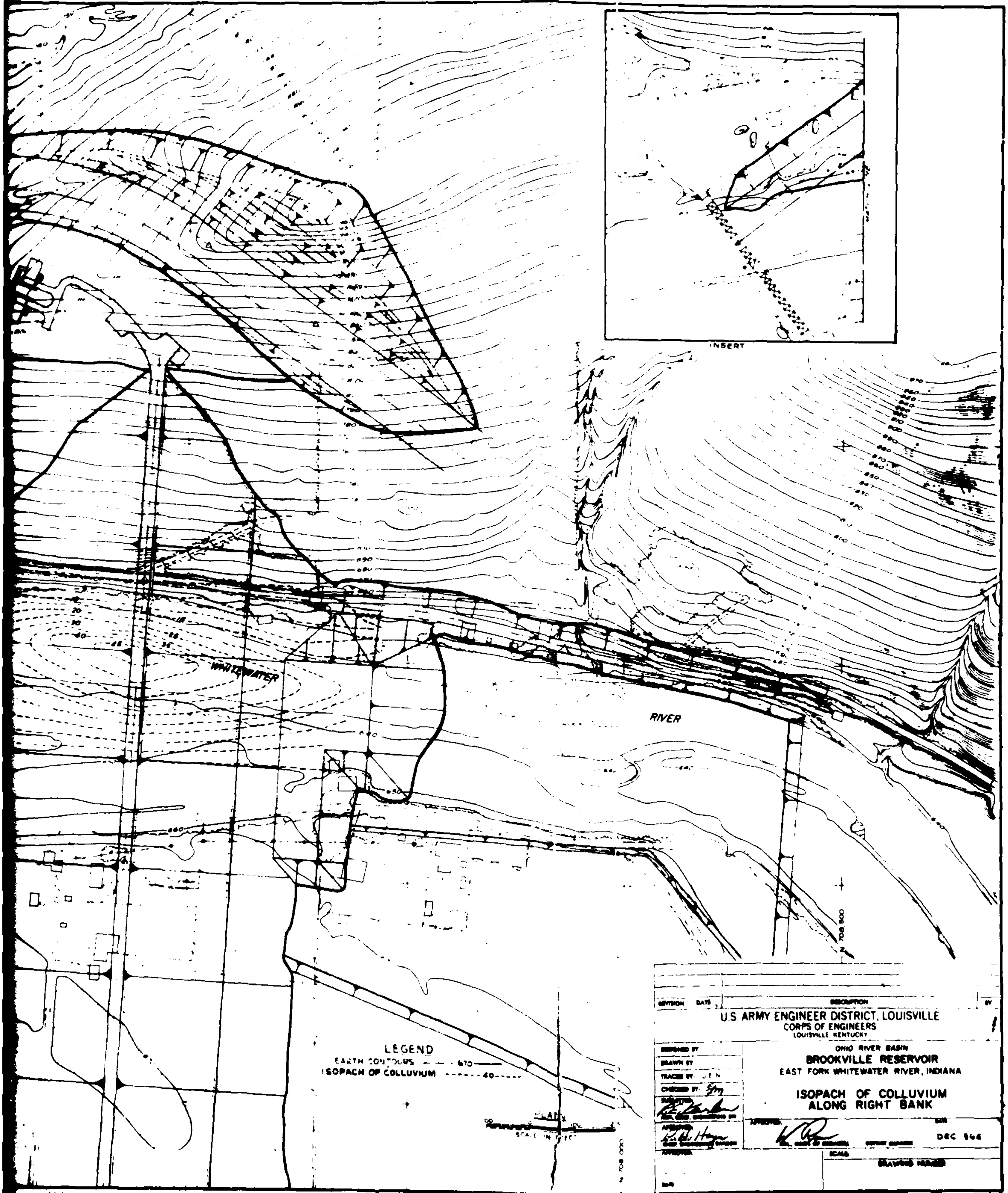
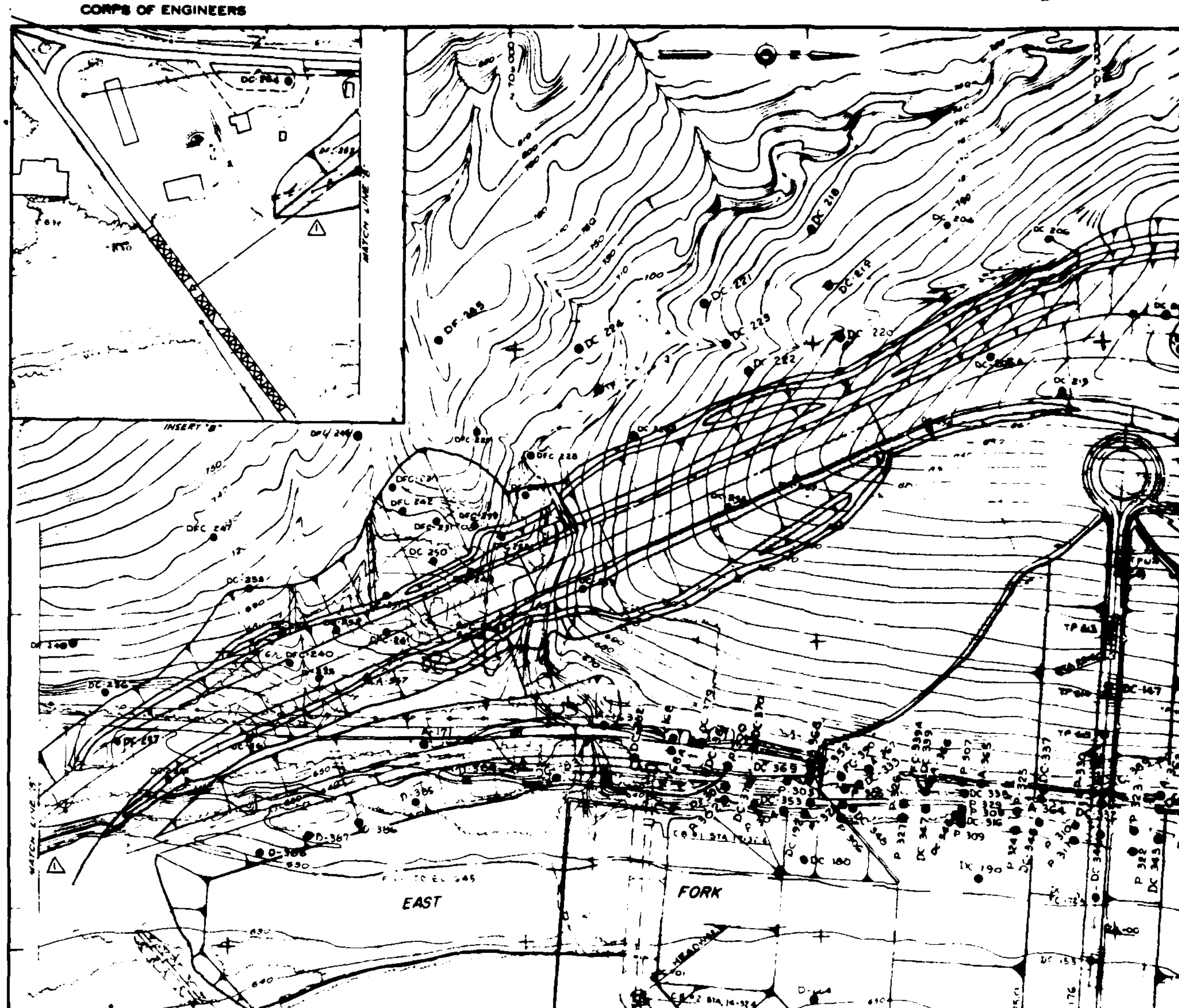
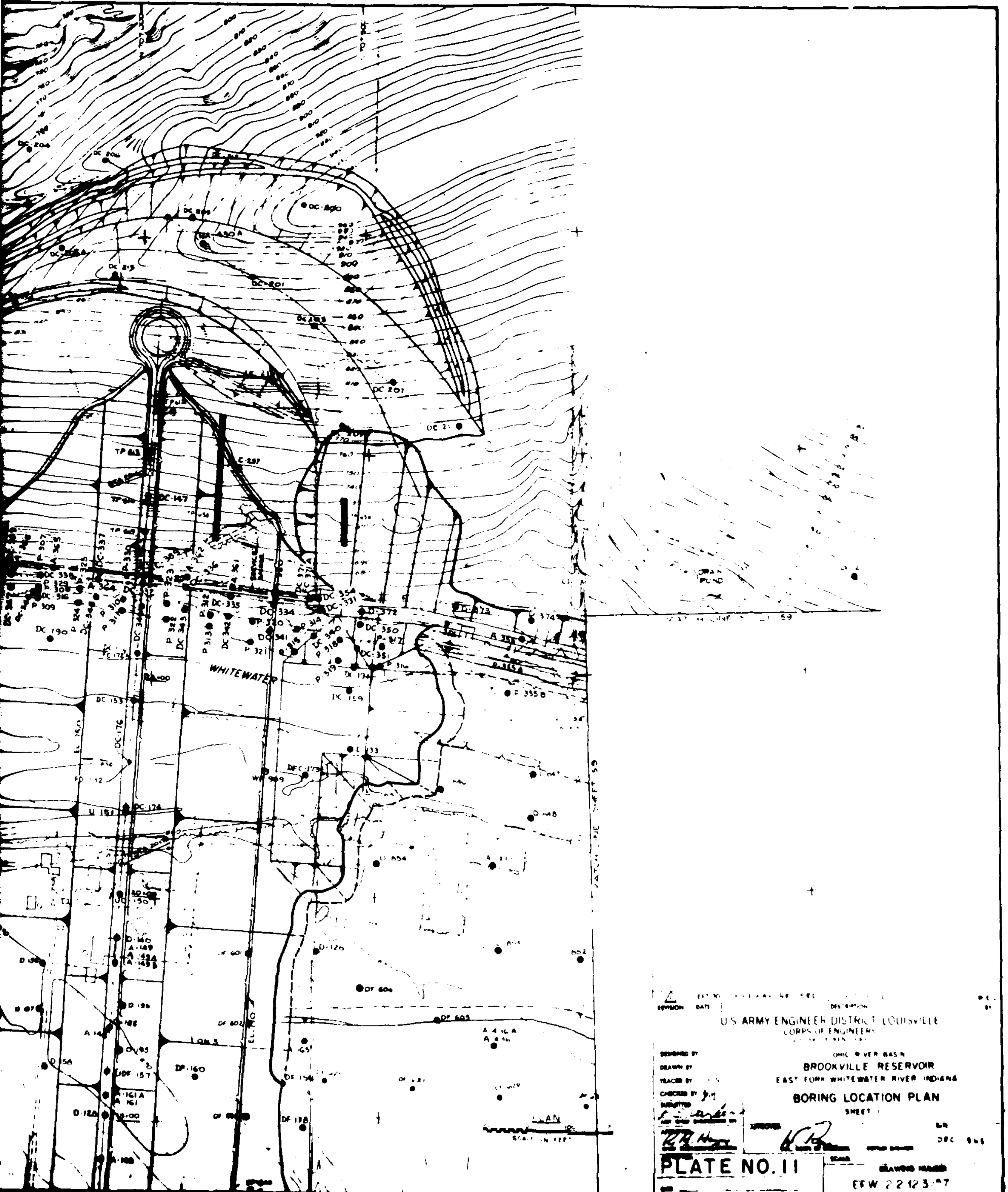

INSERT
WHITEWATER
RIVER
LEGEND
EARTH CONTOURS — 670 —
ISOPACH OF COLLUVIUM ----40----
SCALE IN FEET
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY
OHIO RIVER BASIN
BROOKVILLE RESERVOIR
EAST FORK WHITEWATER RIVER, INDIANA
ISOPACH OF COLLUVIUM
ALONG RIGHT BANK
DEC 1968
DM No 4

PLATE NO. 10

CORPS OF ENGINEERS





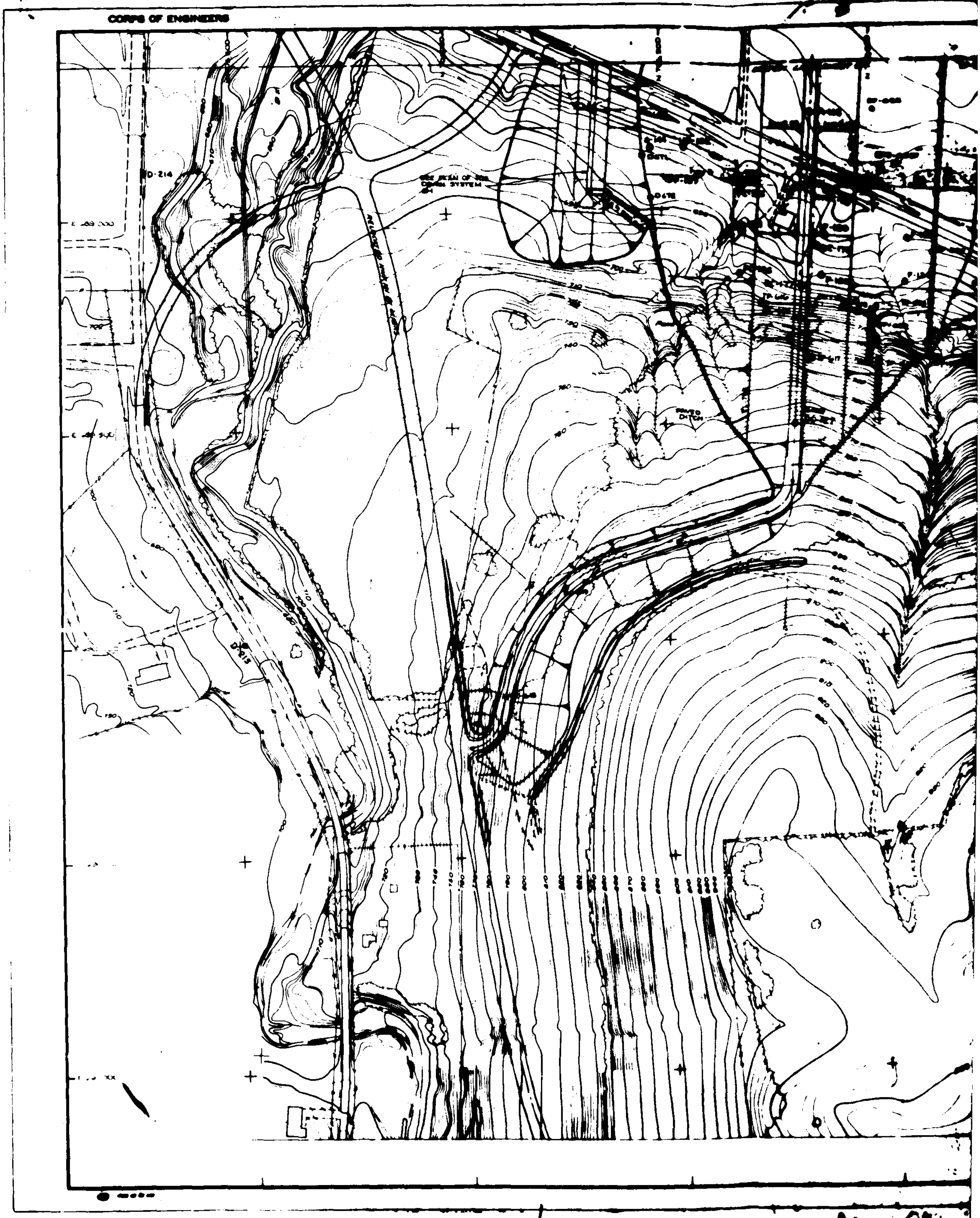
U.S. ARMY ENGINEER DISTRICT LOUISVILLE
CORPS OF ENGINEERS

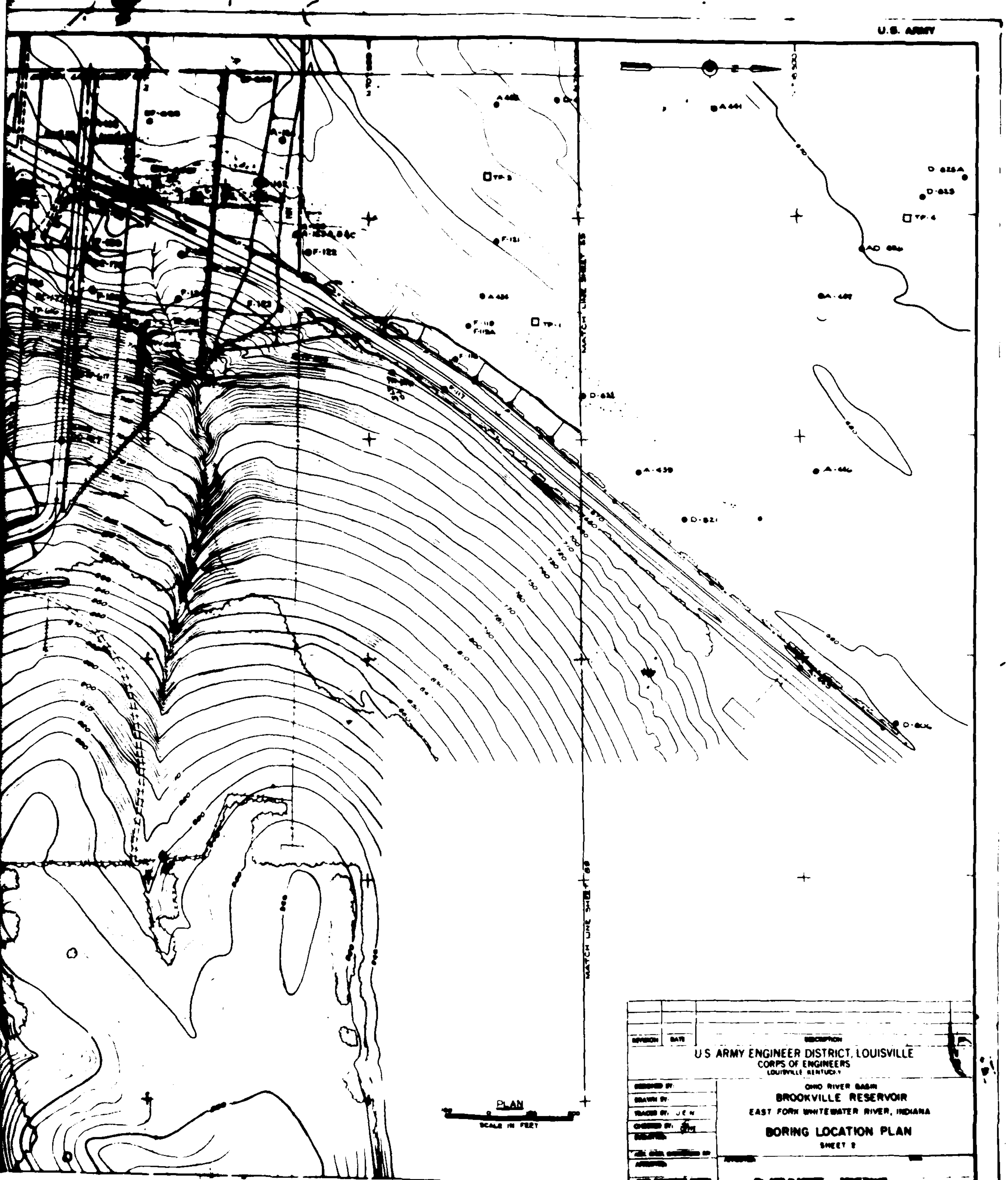
OHIO RIVER BASIN
BROOKVILLE RESERVOIR
EAST FORK WHITEWATER RIVER INDIANA
BORING LOCATION PLAN
SHEET 1

PLATE NO. 11

EFW 22 123/97

RECORD DRAWING AS BUILT


CORPS OF ENGINEERS
D-214
PAVED DITCH



US ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

OHIO RIVER BASIN
BROOKVILLE RESERVOIR
EAST FORK WHITEWATER RIVER, INDIANA

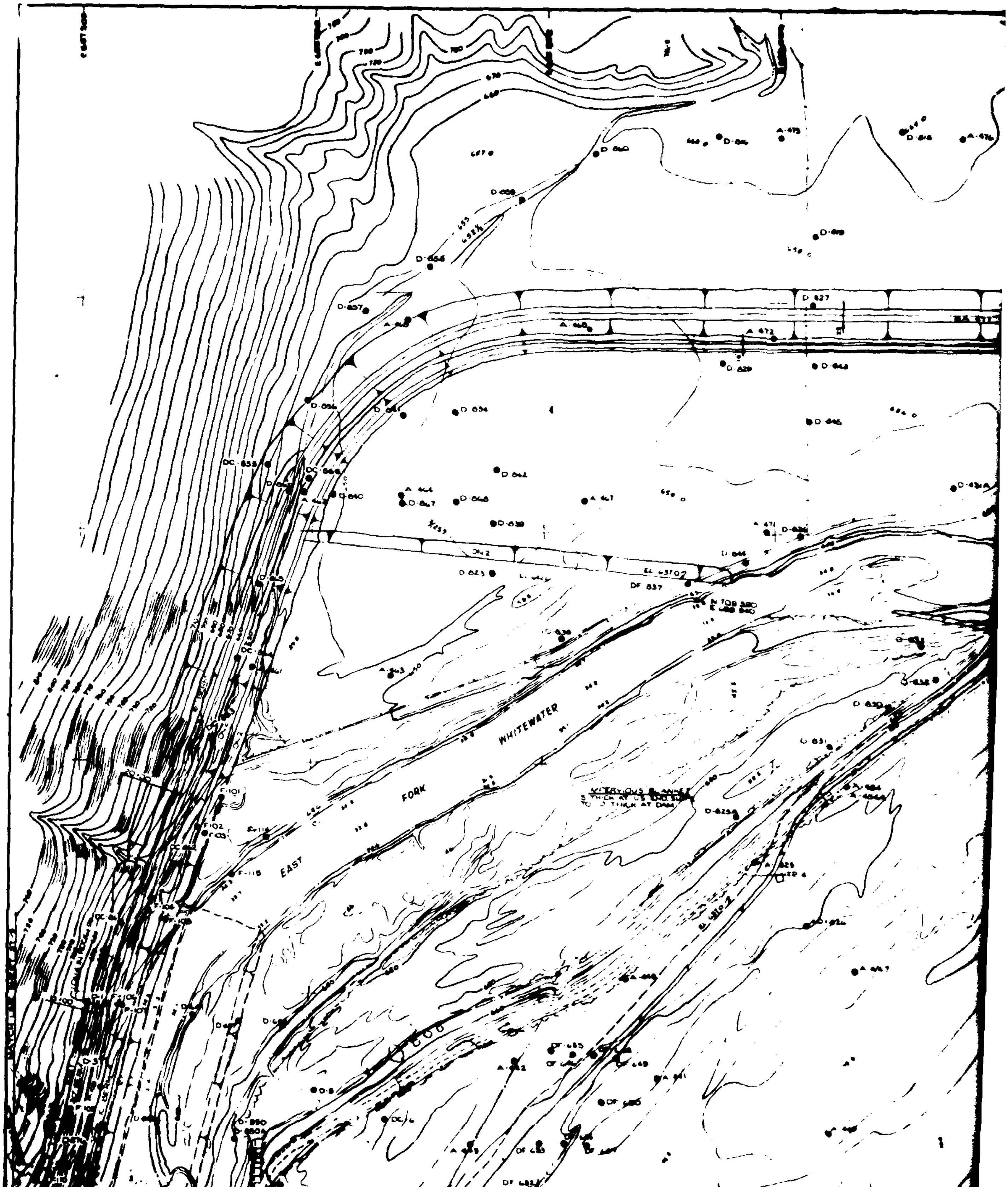
BORING LOCATION PLAN
SHEET 2

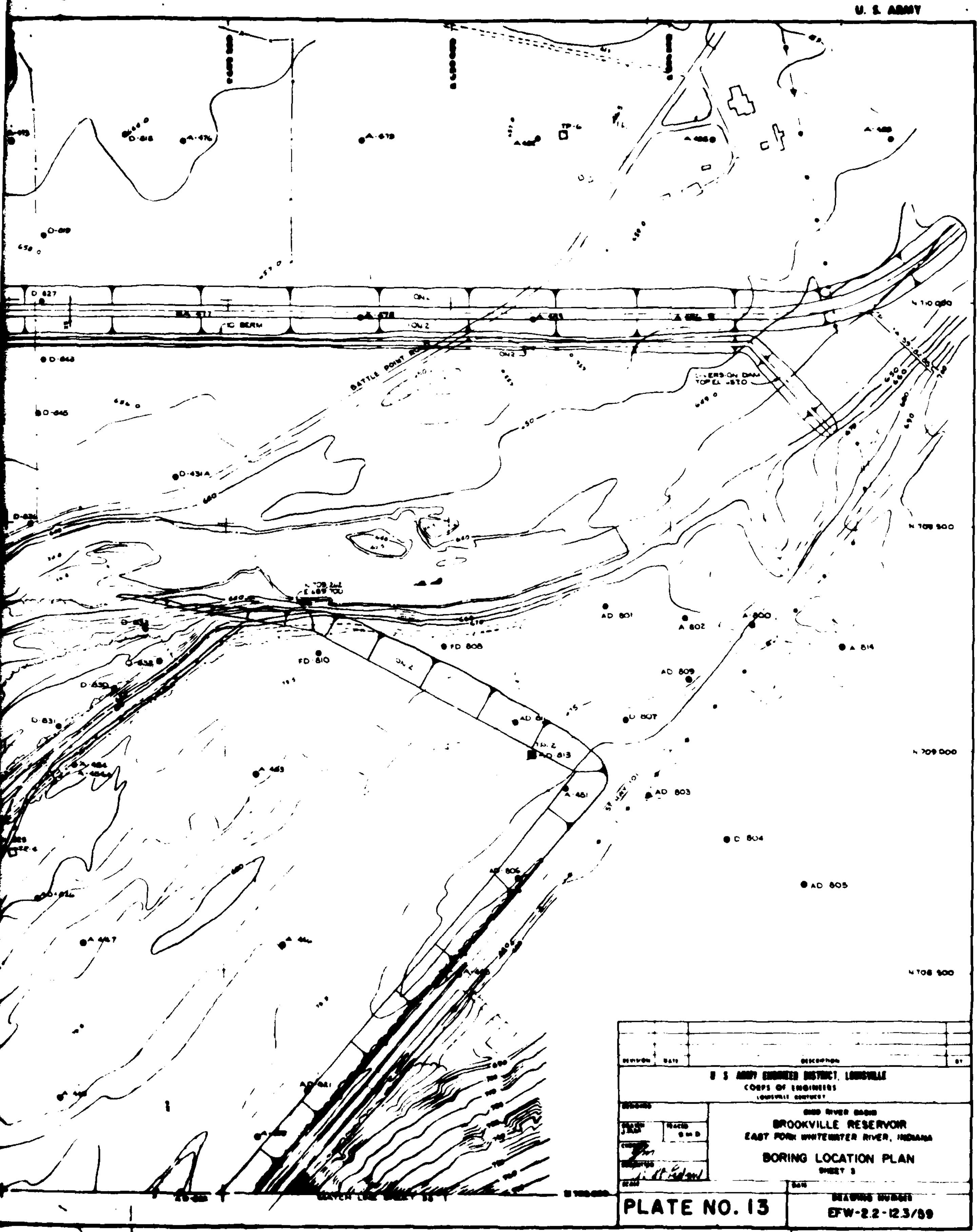
PLATE NO. 12

EFW-2.2-12.3/58

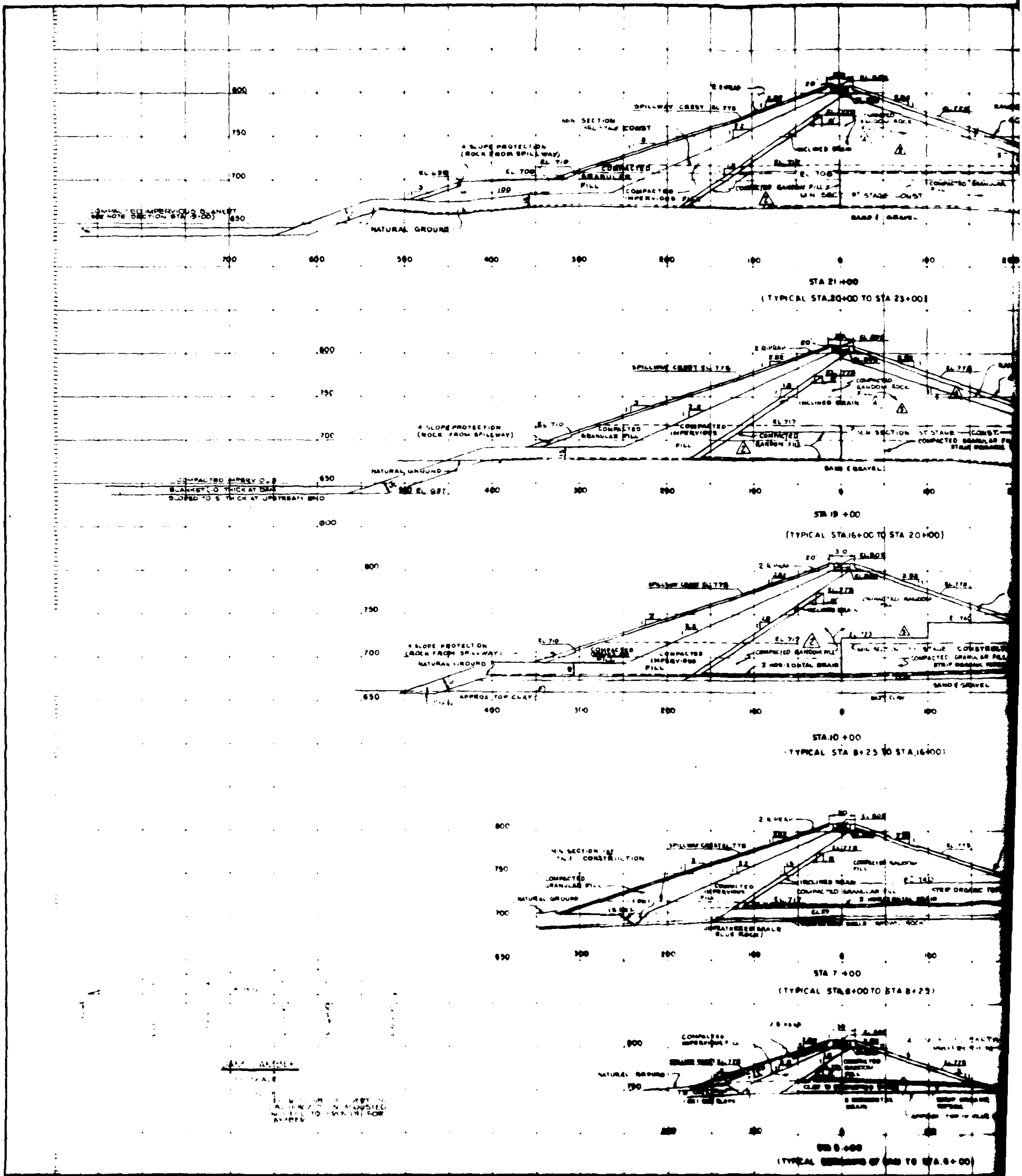
RECORD DRAWING "AS BUILT"

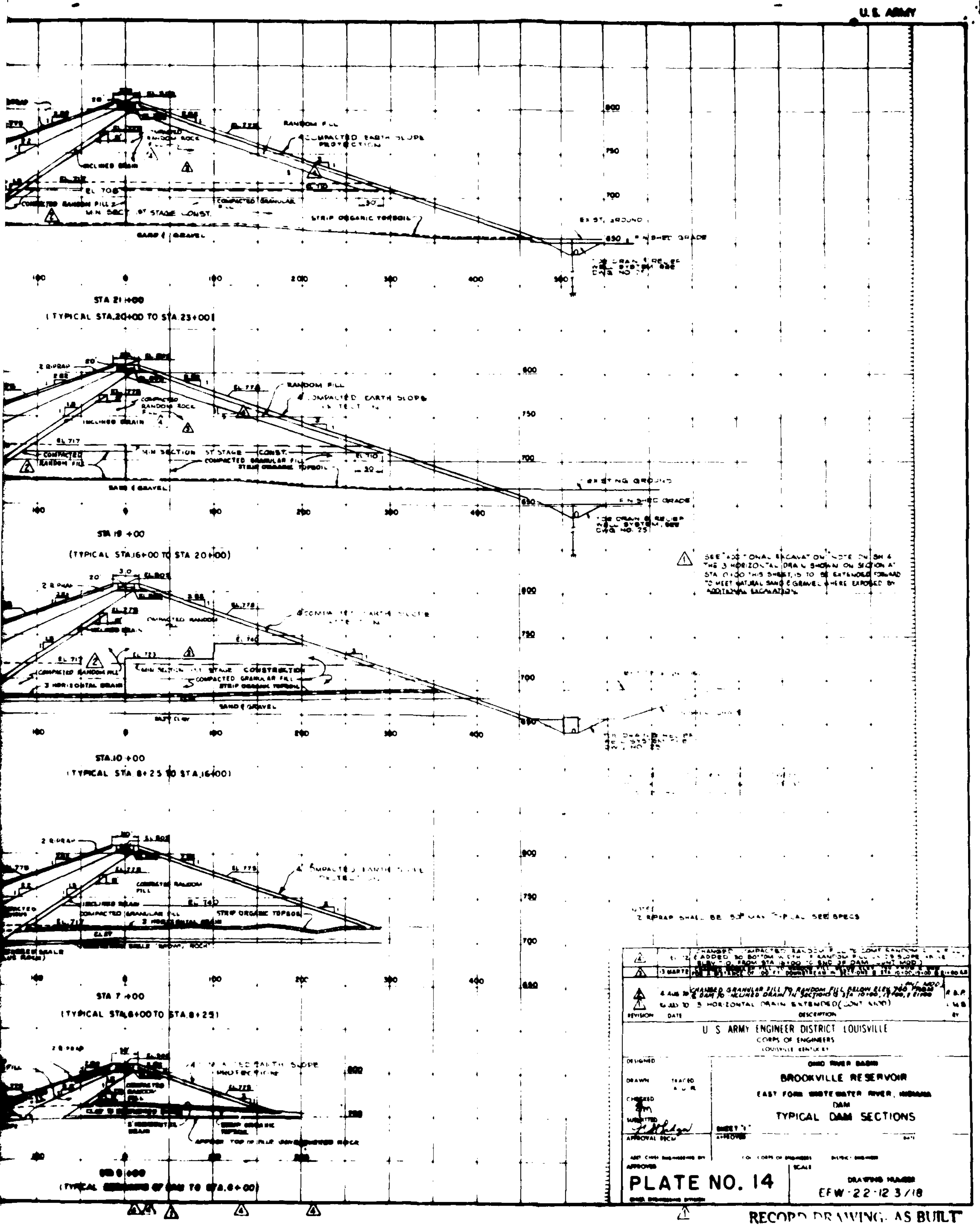
CORPS OF ENGINEERS





RECORD DRAWING AS BUILT


NATURAL GROUND
SPILLWAY CREST EL 775
INCLINED DRAIN
SAND & GRAVEL
STA 21+00
(TYPICAL STA.20+00 TO STA 23+00)
4 SLOPE PROTECTION (ROCK FROM SPILLWAY)
COMPACTED GRANULAR FILL
COMPACTED IMPERVIOUS FILL
COMPACTED RANDOM FILL
STA 19+00
(TYPICAL STA.16+00 TO STA 20+00)
APPROX TOP CLAY
STA.10+00
(TYPICAL STA 8+25 TO STA.16+00)
MIN SECTION 1ST STAGE CONSTRUCTION
STA 7+00
(TYPICAL STA.6+00 TO STA 8+25)

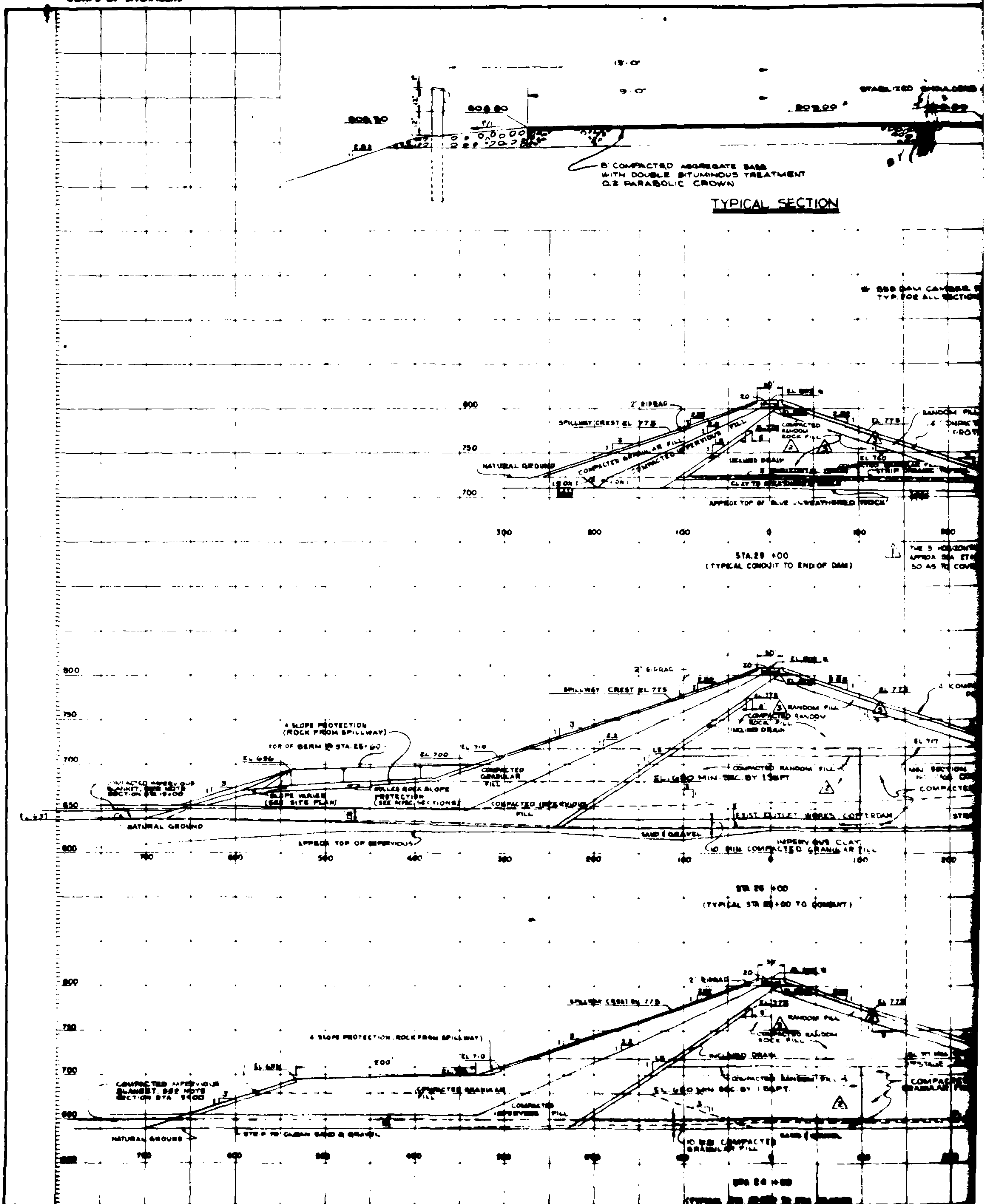


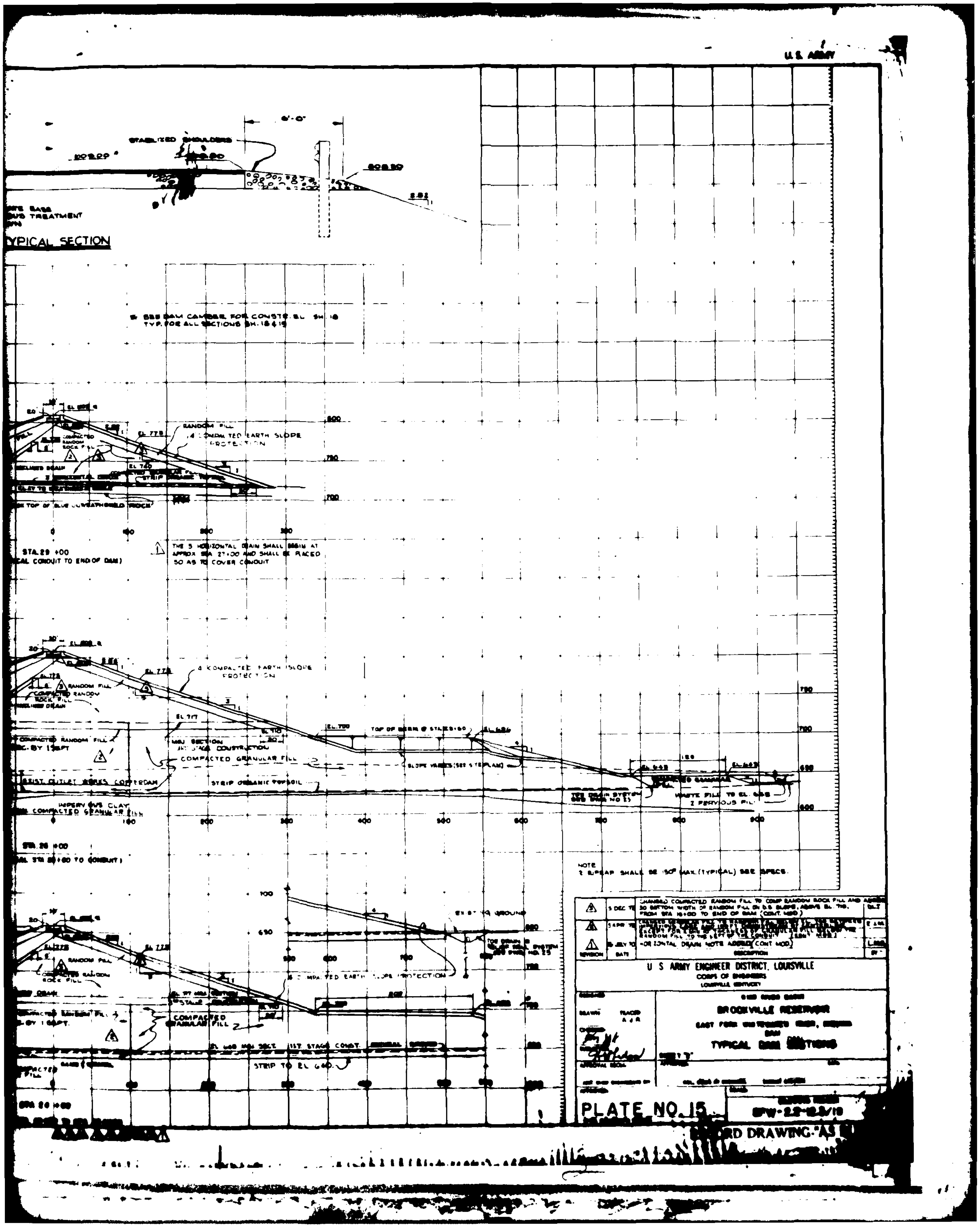
RECORD DRAWING AS BUILT

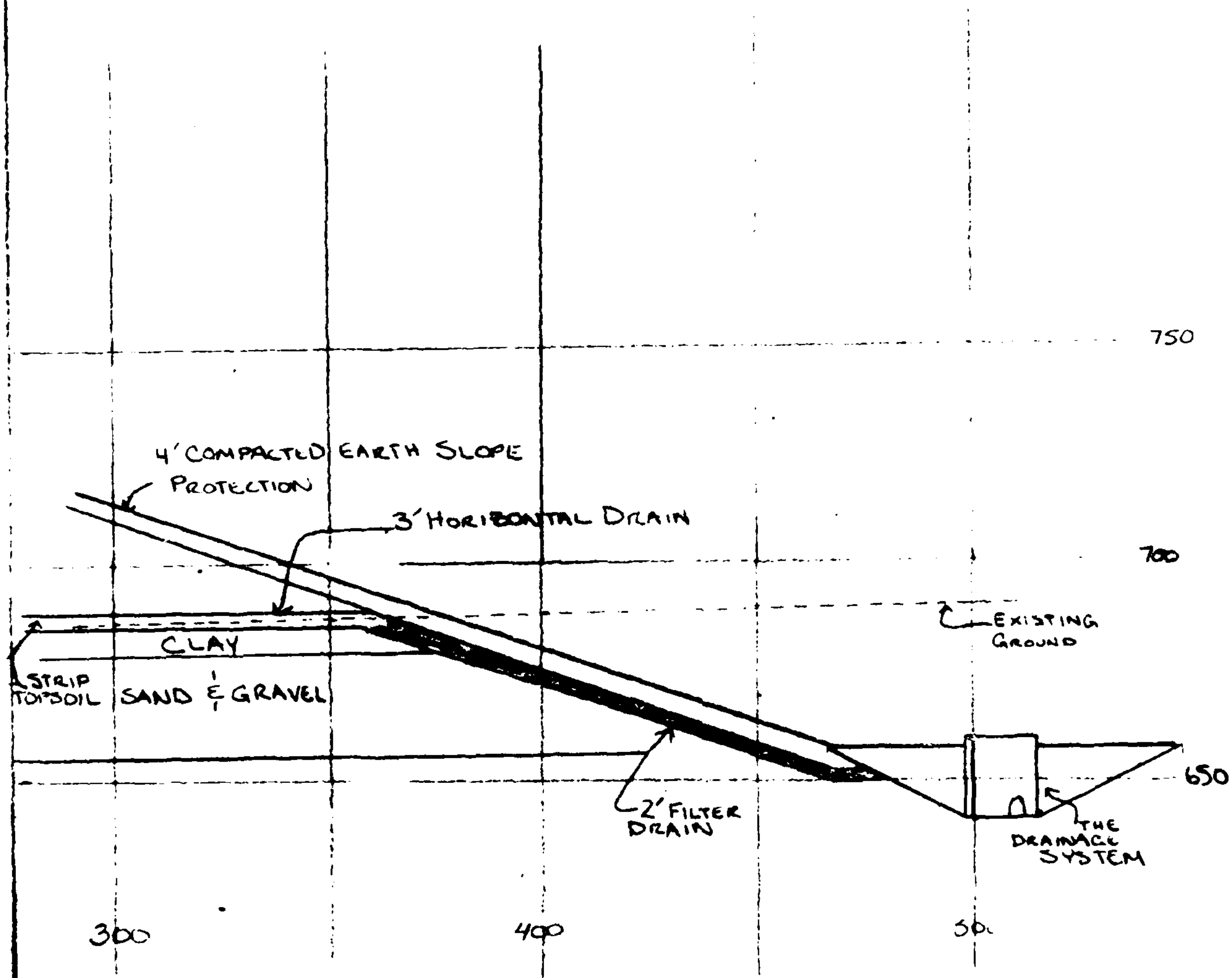
1

2

CORPS OF ENGINEERS

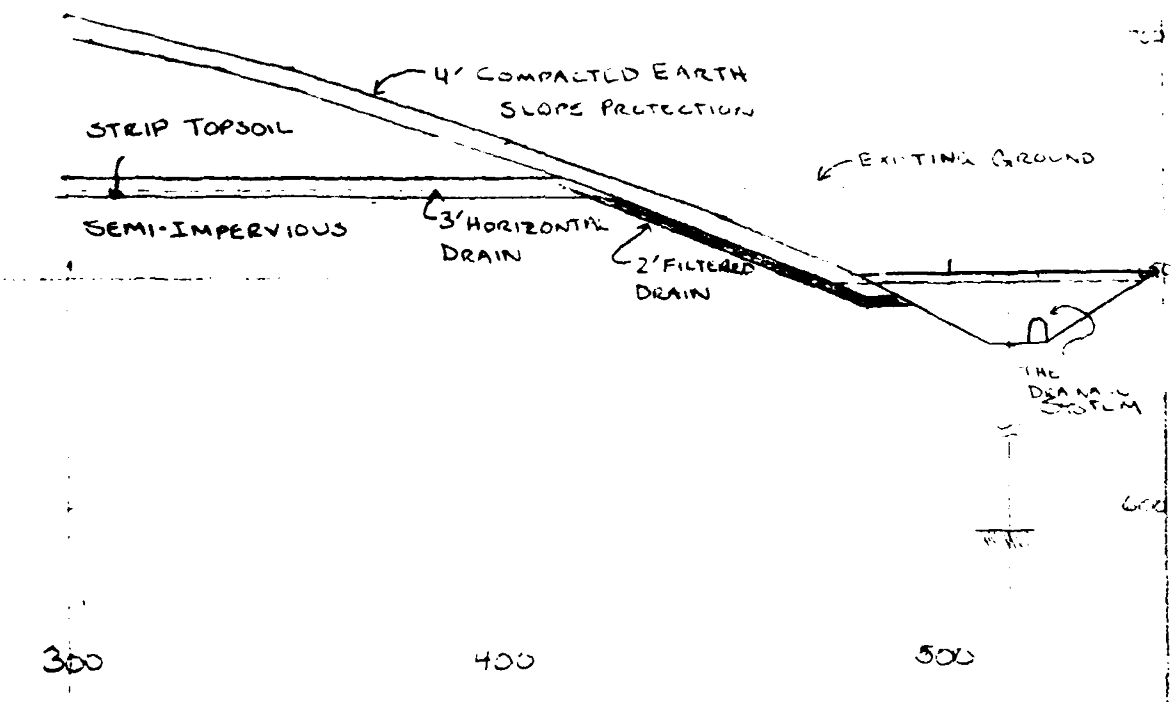



U.S. ARMY
STABILIZED SHOULDERS
TYPICAL SECTION
RANDOM FILL
COMPACTED EARTH SLOPE PROTECTION
THE 5 HORIZONTAL DRAIN SHALL BEGIN AT APPROX STA. 27+00 AND SHALL BE PLACED SO AS TO COVER CONDUIT
STA. 29 +00
4 COMPACTED EARTH SLOPE PROTECTION
COMPACTED RANDOM FILL
COMPACTED GRANULAR FILL
STRIP ORGANIC TOPSOIL
IMPERVIOUS CLAY
SLOPE VARIES (SEE STEP PLAN)
WASTE FILL TO EL.
Z PERVIOUS FILL
NOTE
Z RIPRAP SHALL BE 150# MAX. (TYPICAL) SEE SPECS.
EXISTING GROUND
COMPACTED GRANULAR FILL
STRIP TO EL 640.
U S ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY
BROOKVILLE RESERVOIR
TYPICAL DAM SECTIONS
PLATE NO. 15
RECORD DRAWING "AS BUILT"



TREATMENT BETWEEN 11+75 - 12+25

BROOKVILLE LAKE
ADDITIONAL HORIZONTAL DRAINS
SHEET 1 OF 2



TREATMENT BETWEEN 19+50 - 20+00

BROOKVILLE LAKE
ADDITIONAL HORIZONTAL DRAINS
SHEET 2 OF 2

PLATE 15A

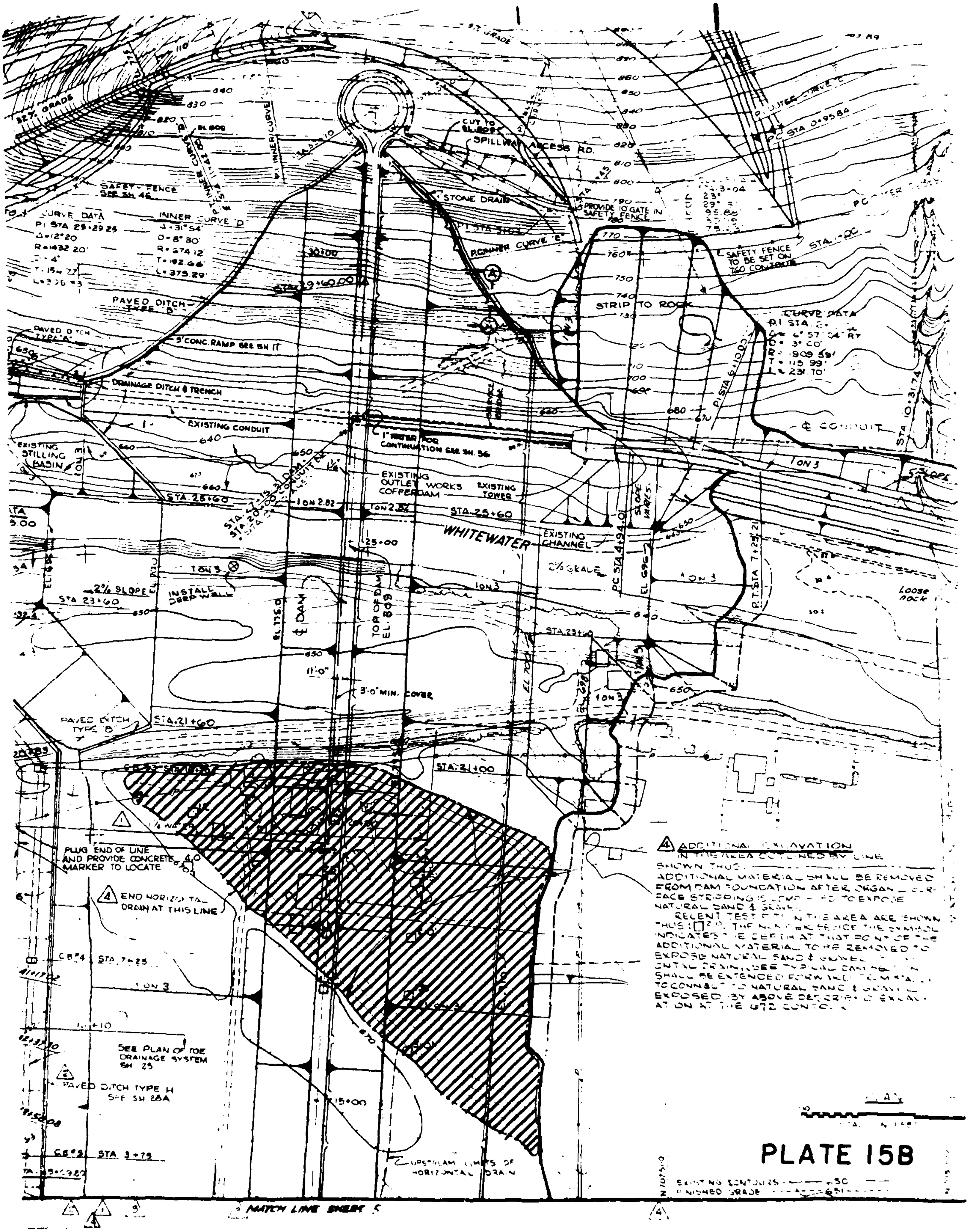
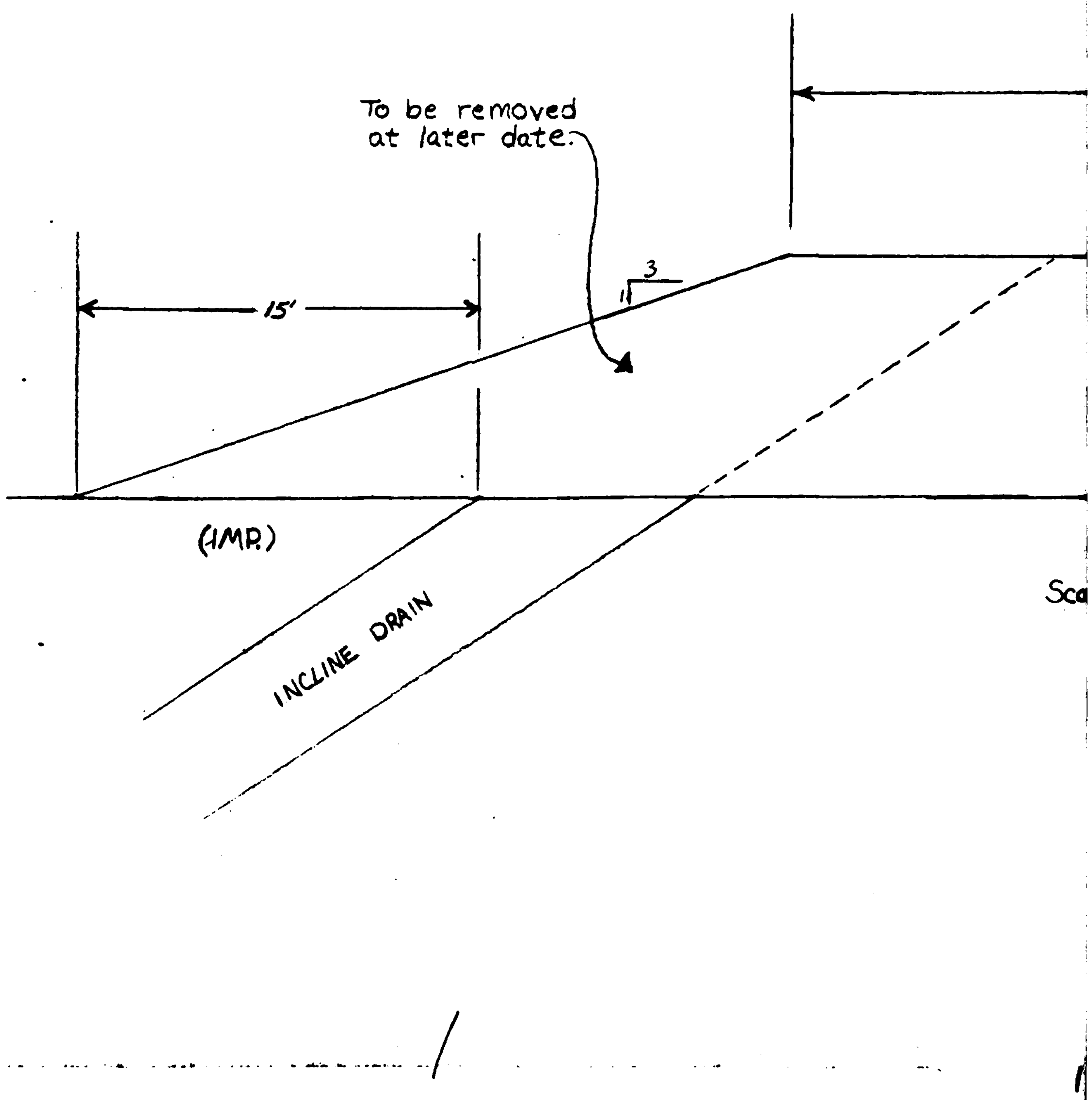
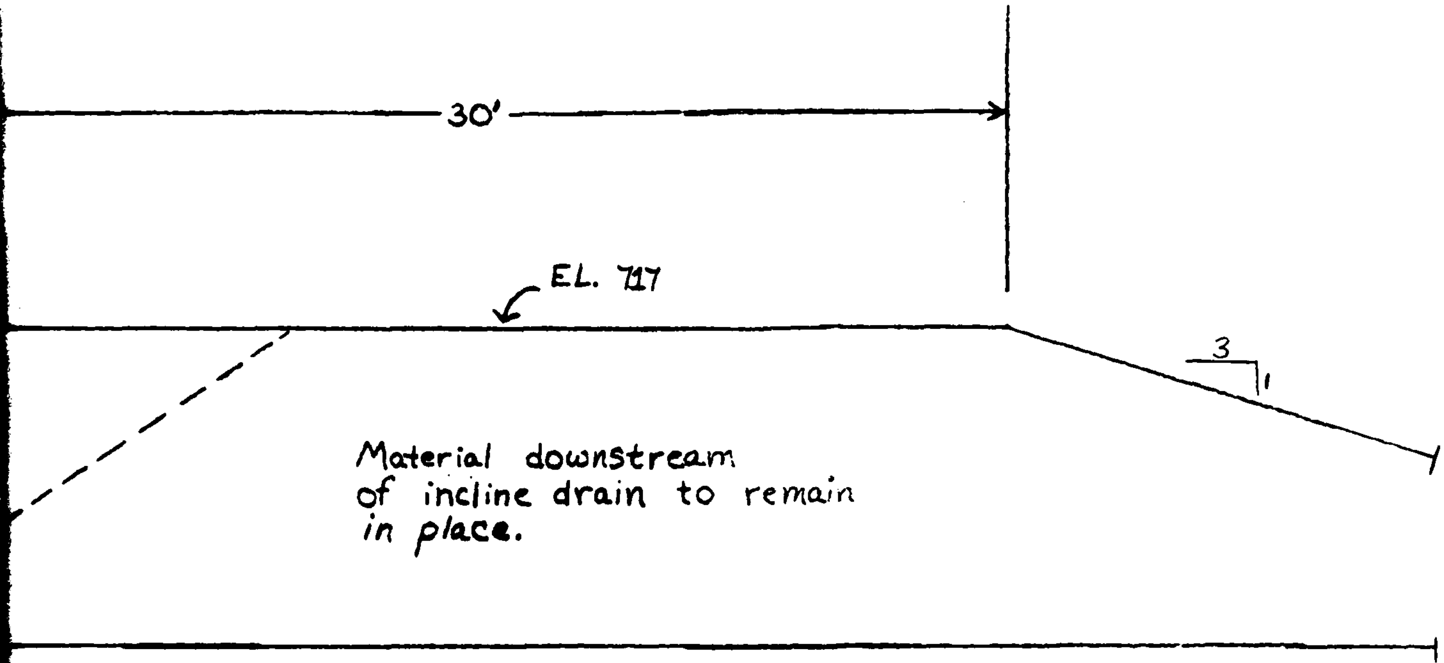

SPILLWAY ACCESS RD.
STONE DRAIN
SAFETY FENCE SEE SH. 46
CURVE DATA
INNER CURVE 'D'
PAVED DITCH TYPE 'B'
5' CONC. RAMP SEE SH 17
DRAINAGE DITCH & TRENCH
EXISTING CONDUIT
EXISTING STILLING BASIN
EXISTING OUTLET WORKS COFFERDAM
EXISTING TOWER
STRIP TO ROCK
SAFETY FENCE TO BE SET ON 760 CONTOUR
PROVIDE 10' GATE IN SAFETY FENCE
℄ CONDUIT
WHITEWATER
EXISTING CHANNEL
2% GRADE
2% SLOPE
INSTALL DEEP WELL
℄ DAM
TOP OF DAM EL. 809
3'-0" MIN. COVER
PAVED DITCH TYPE B
PLUG END OF LINE AND PROVIDE CONCRETE MARKER TO LOCATE
END HORIZONTAL DRAIN AT THIS LINE
SEE PLAN OF TOE DRAINAGE SYSTEM SH. 29
PAVED DITCH TYPE H SEE SH 28A
UPSTREAM LIMITS OF HORIZONTAL DRAIN
Loose rock
ADDITIONAL EXCAVATION
EXISTING CONTOURS
FINISHED GRADE
MATCH LINE SHEET 5

PLATE 15B



To be removed at later date.
3
1
15'
(TMP.)
INCLINE DRAIN
Sca

Upstream toe of dike is to be a minimum of 15 ft. upstream of upstream edge of the incline drain and constructed on a 3 on 1 slope to a minimum elev. of 717.



(RANDOM)

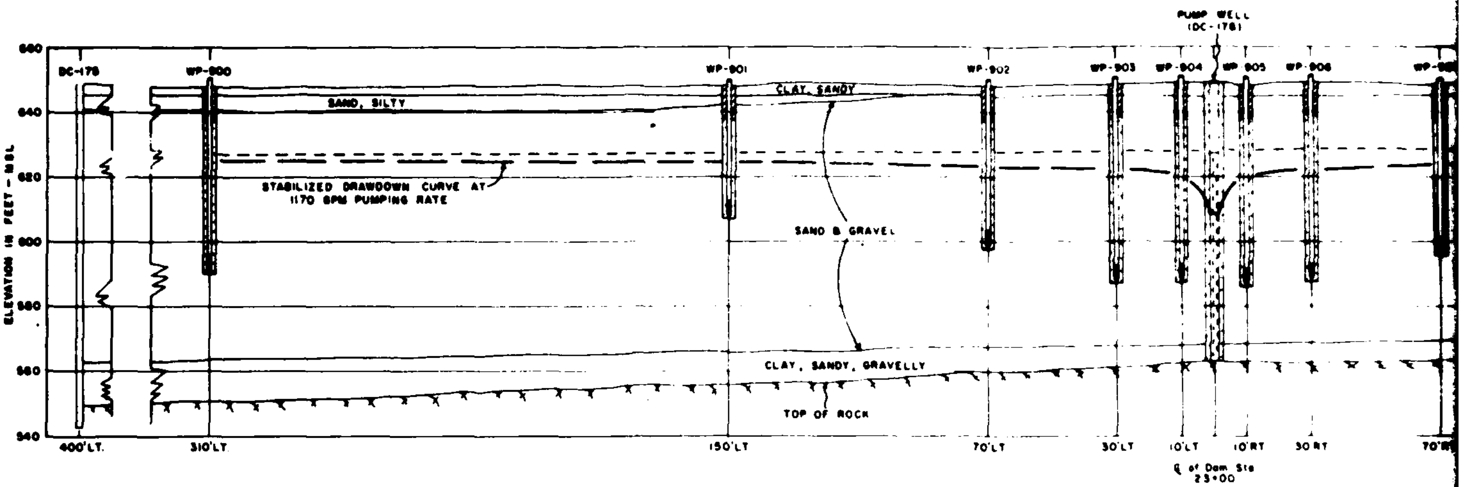
Scale: 1" = 5'

Temporary Protection Dike

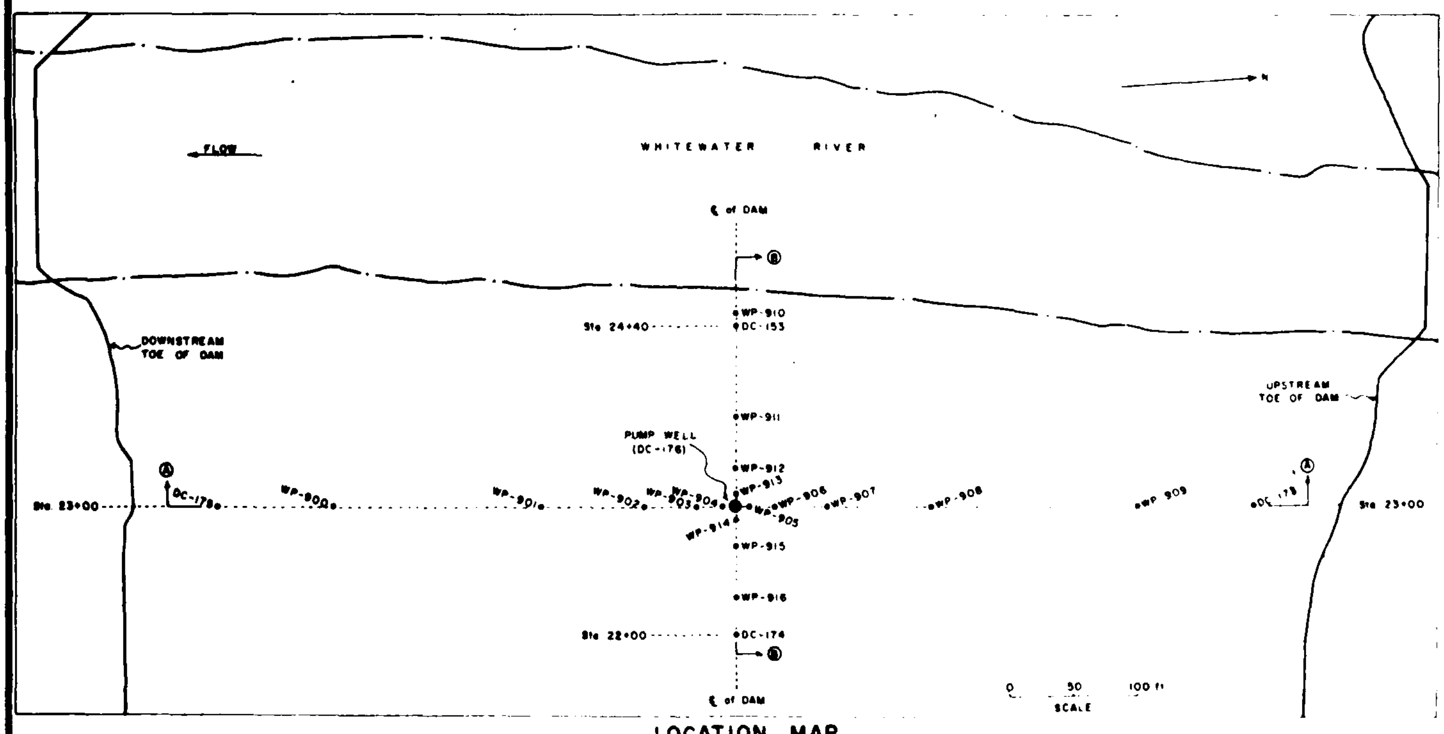
Dwg. No. BRO SK-1

Contr. No. DACW27-70-C-0079

Plate 15C

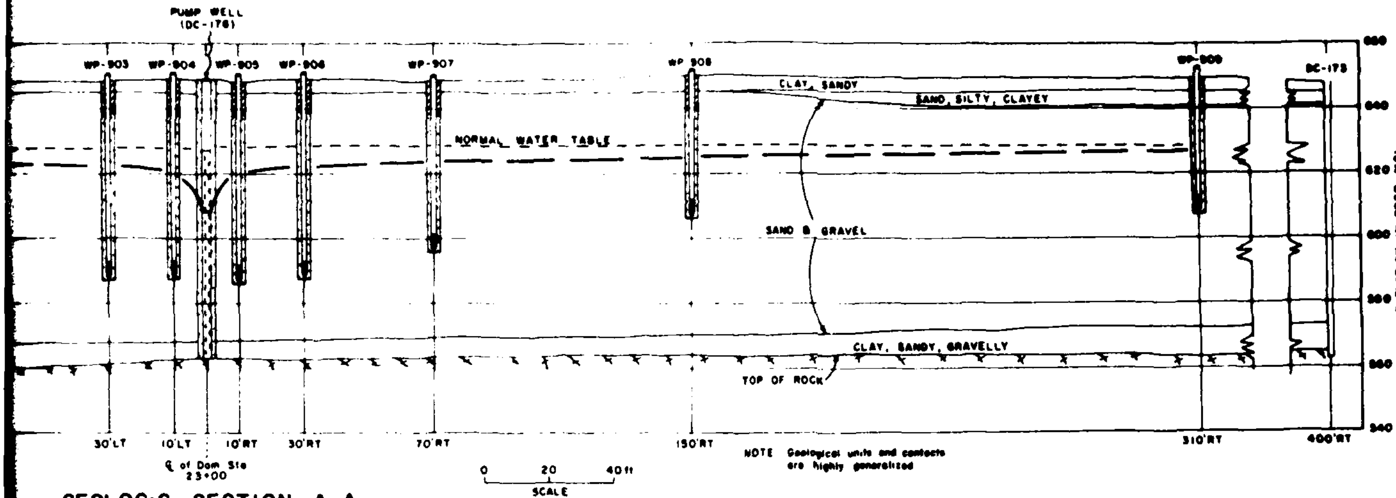


GEOLOGIC SECTION A-A

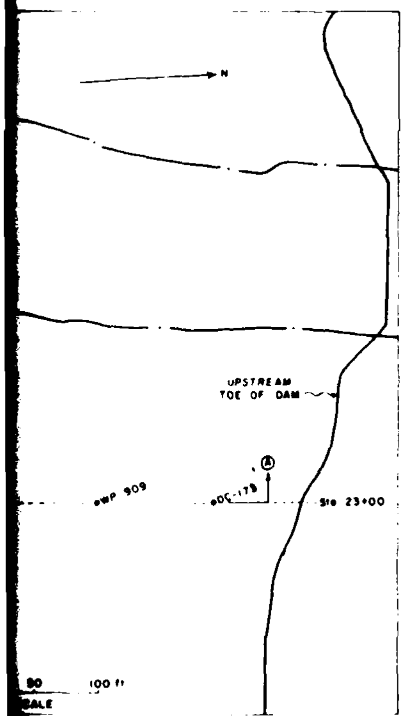


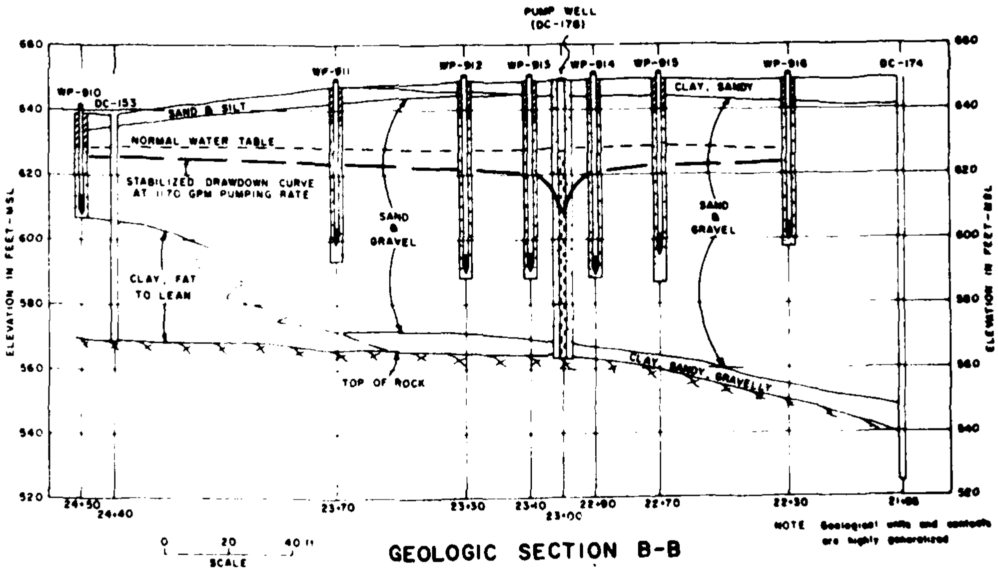
LOCATION MAP

REVISIONS



GEOLOGIC SECTION A-A





GEOLOGIC SECTION B-B

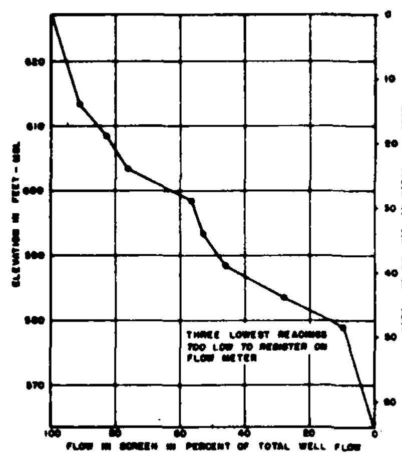
U.S. ARMY ENG DIST LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE KENTUCKY

BROOKVILLE RESERVOIR
WHITEWATER RIVER, INDIANA

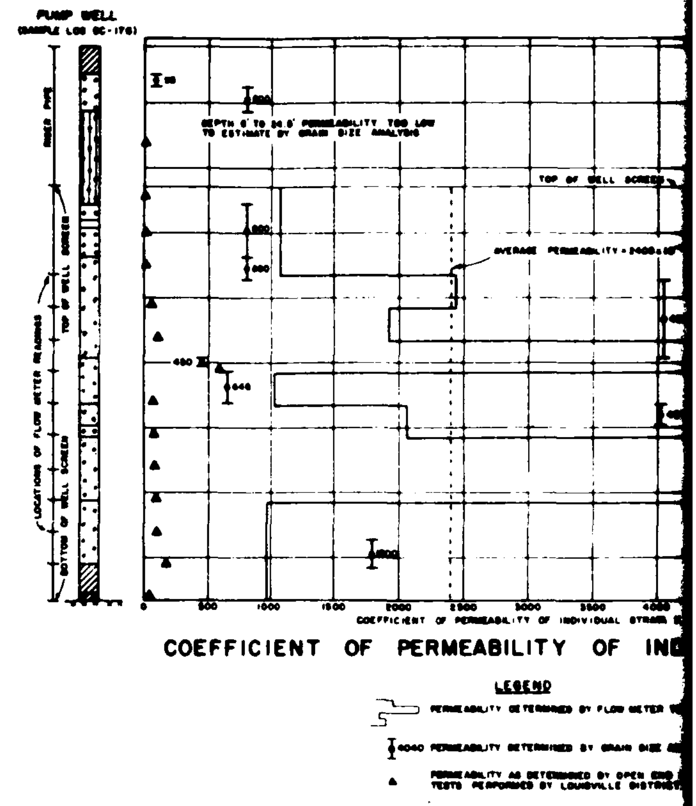
GEOLOGIC SECTIONS
AND
LOCATION MAP

DRAWING NO

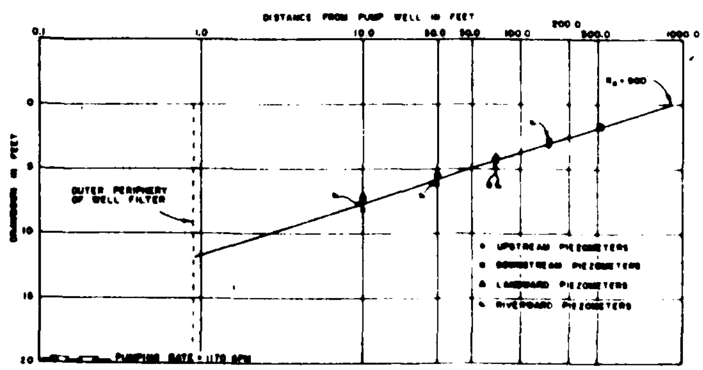
2



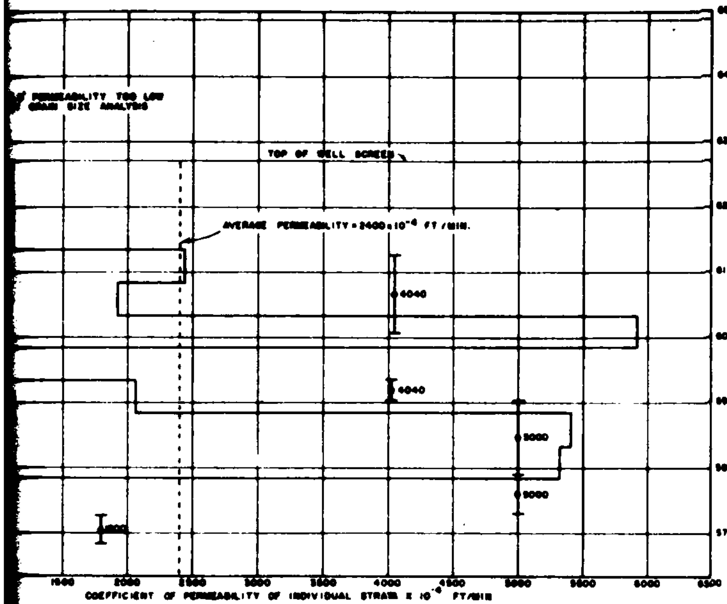
FLOW IN WELL AT VARIOUS DEPTHS
IN PERCENT OF TOTAL FLOW



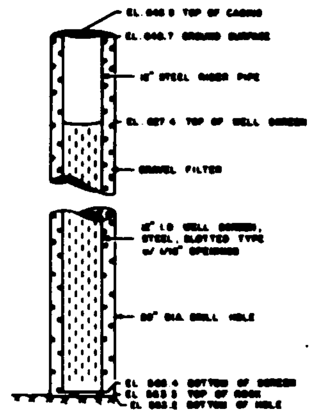
COEFFICIENT OF PERMEABILITY OF IND



DRAWDOWN CURVE
(SEMI LOG SCALE)

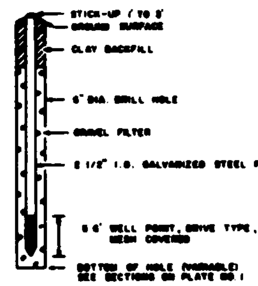


NT OF PERMEABILITY OF INDIVIDUAL STRATA



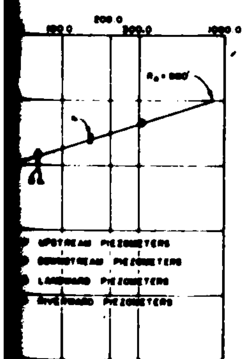
DETAIL OF PUMP WELL

NOT TO SCALE



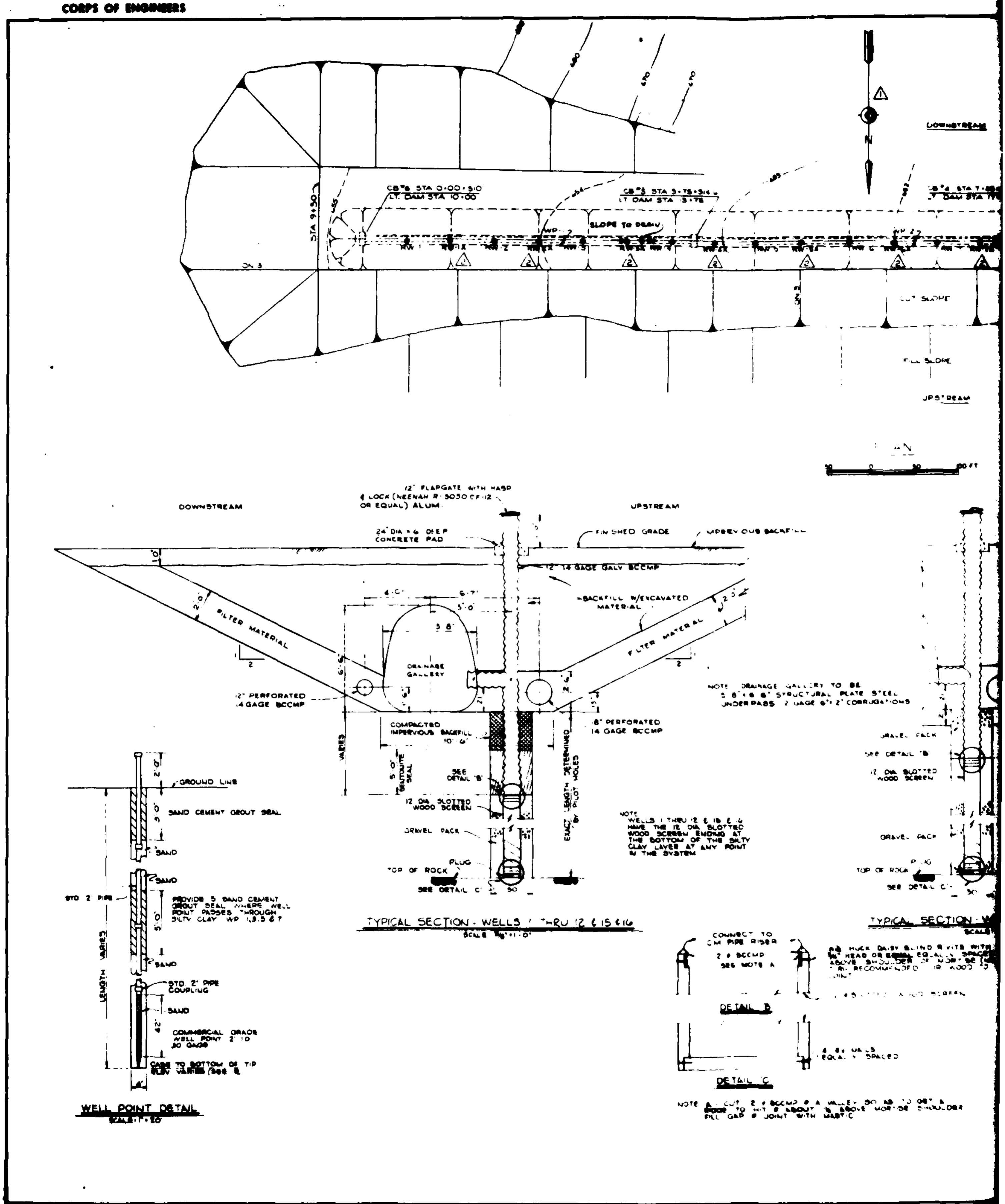
DETAIL OF TYPICAL PIEZOMETER

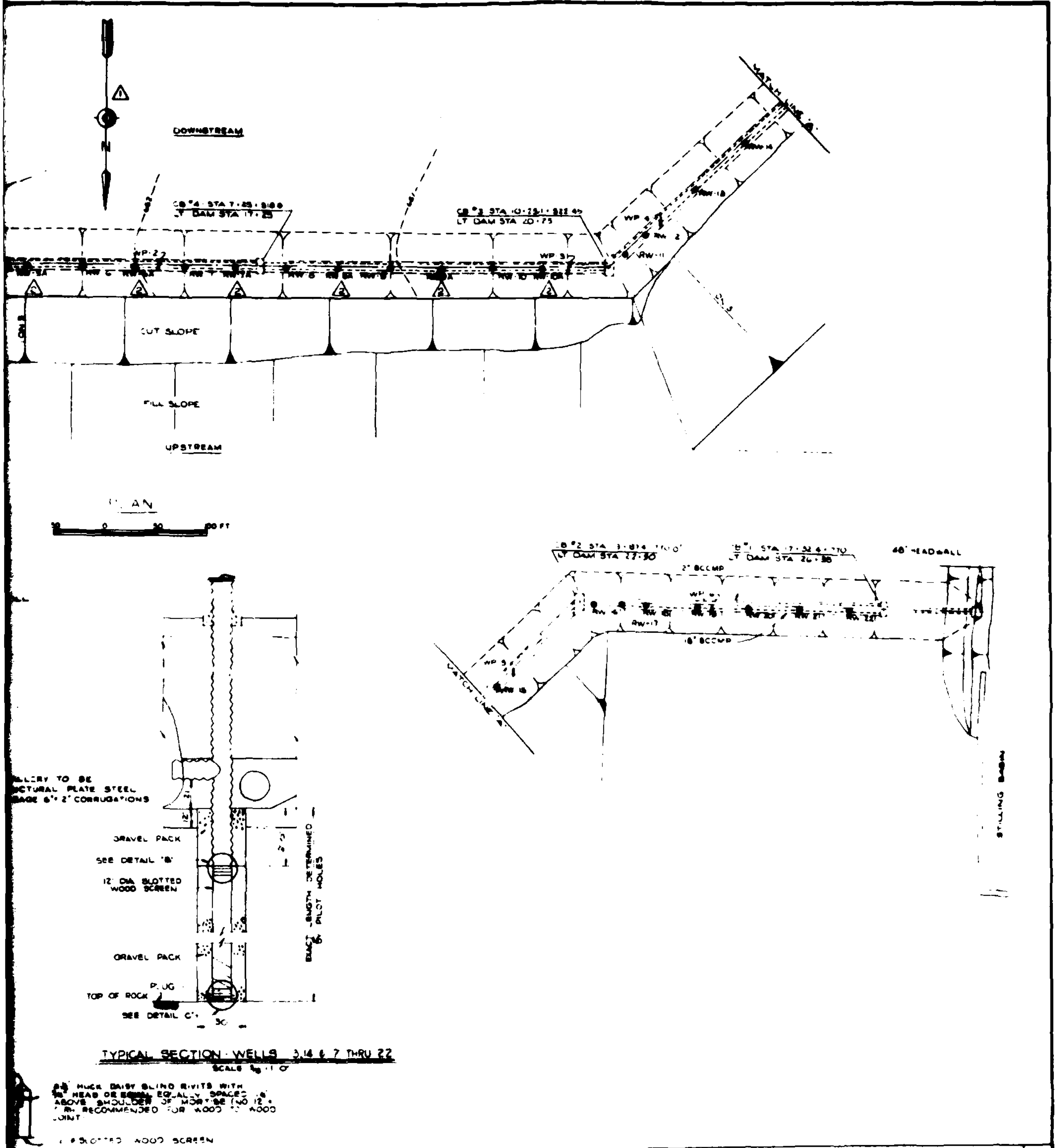
NOT TO SCALE



FLOW METER & PERMEABILITY DATA, DRAWDOWN CURVE AND DETAIL OF PUMP WELL & TYPICAL PIEZOMETER

CORPS OF ENGINEERS





1	NOV 71	ADDED ADDITIONAL RELIEF WELLS (CONT MOD)	
2	APR 70	REV. PER AMDT NO 1 DATED 4 FEB 1970	JRB
REVISION	DATE	DESCRIPTION	BY

U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

OHIO RIVER BASIN
BROOKVILLE RESERVOIR
EAST FORK WHITEWATER RIVER, INDIANA
TOE DRAINAGE SYSTEM
PLAN

DESIGNED
DRAWN
TRACED S.M.D.
CHECKED
SUBMITTED
SCALE AS SHOWN

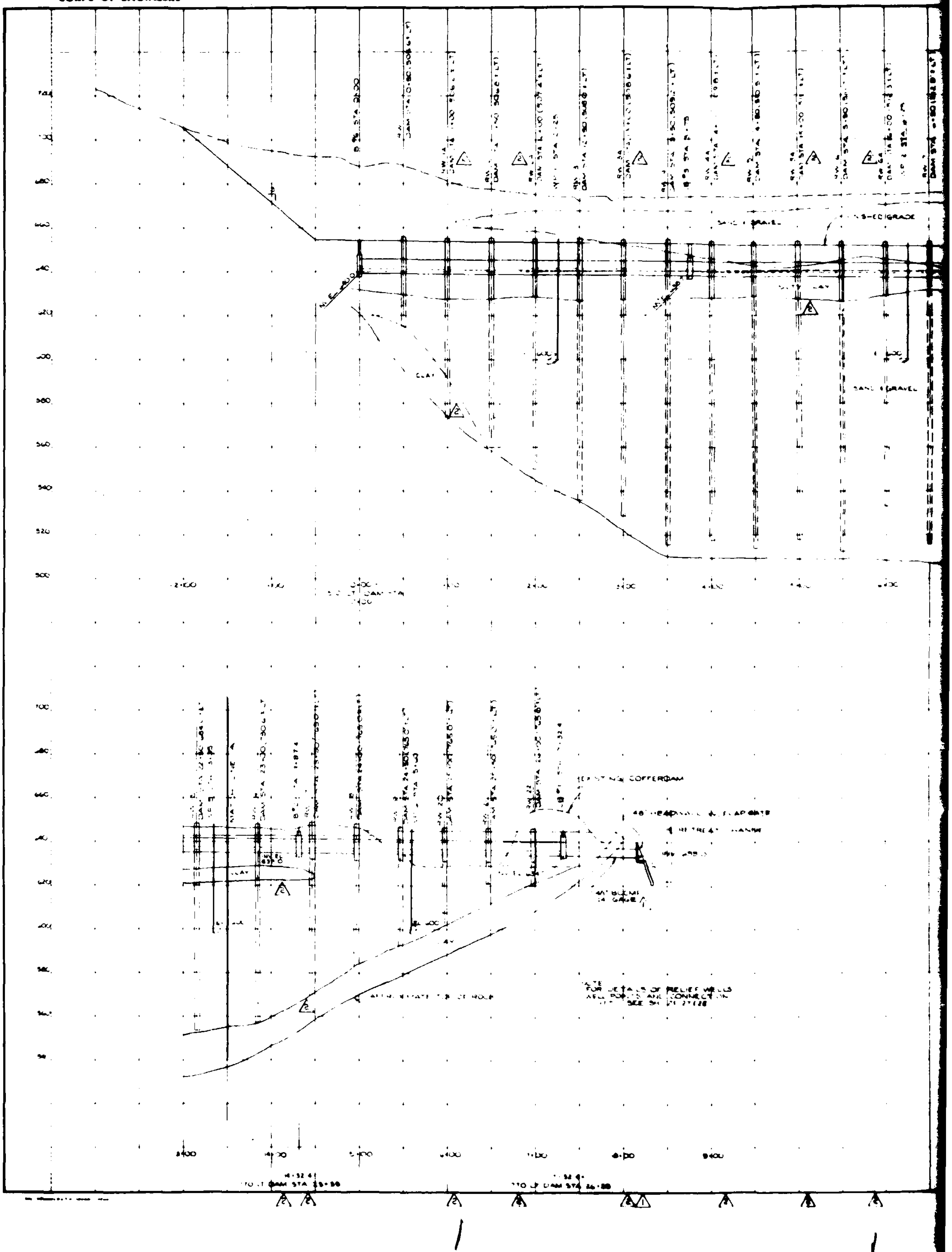
PLATE NO. 18

DRAWING NUMBER EFW-2.2-12 3/28

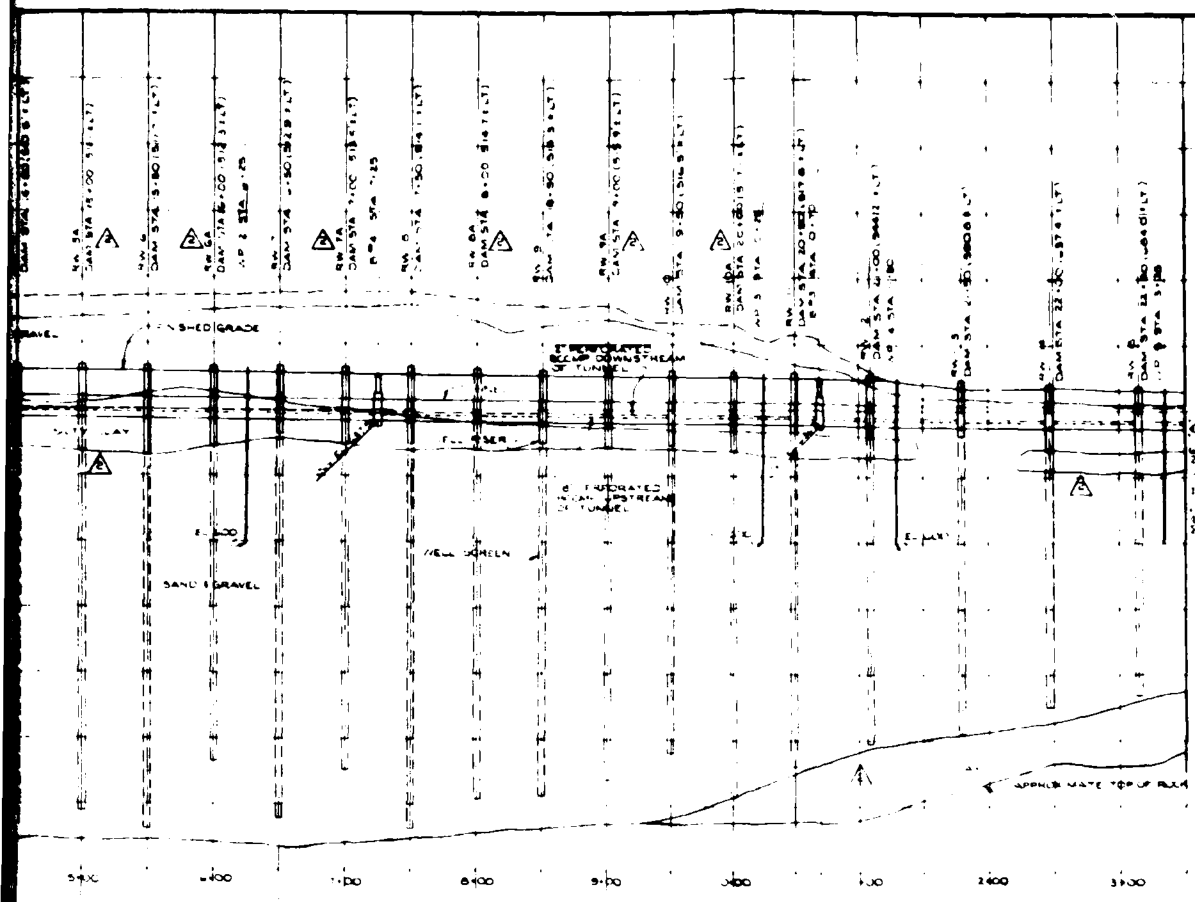
RECORD DRAWING "AS BUILT"

2

CORPS OF ENGINEERS



U. S. ARMY



U. S. ARMY ENGINEER DISTRICT, LOUISVILLE

CORPS OF ENGINEERS

LOUISVILLE, KENTUCKY

OHIO RIVER BASIN

BROOKVILLE RESERVOIR

EAST FORK WHITEWATER RIVER, INDIANA

DAM

TOE DRAINAGE SYSTEM

PROFILE

SCALE: AS SHOWN

PLATE NO. 19

DRAWING NUMBER

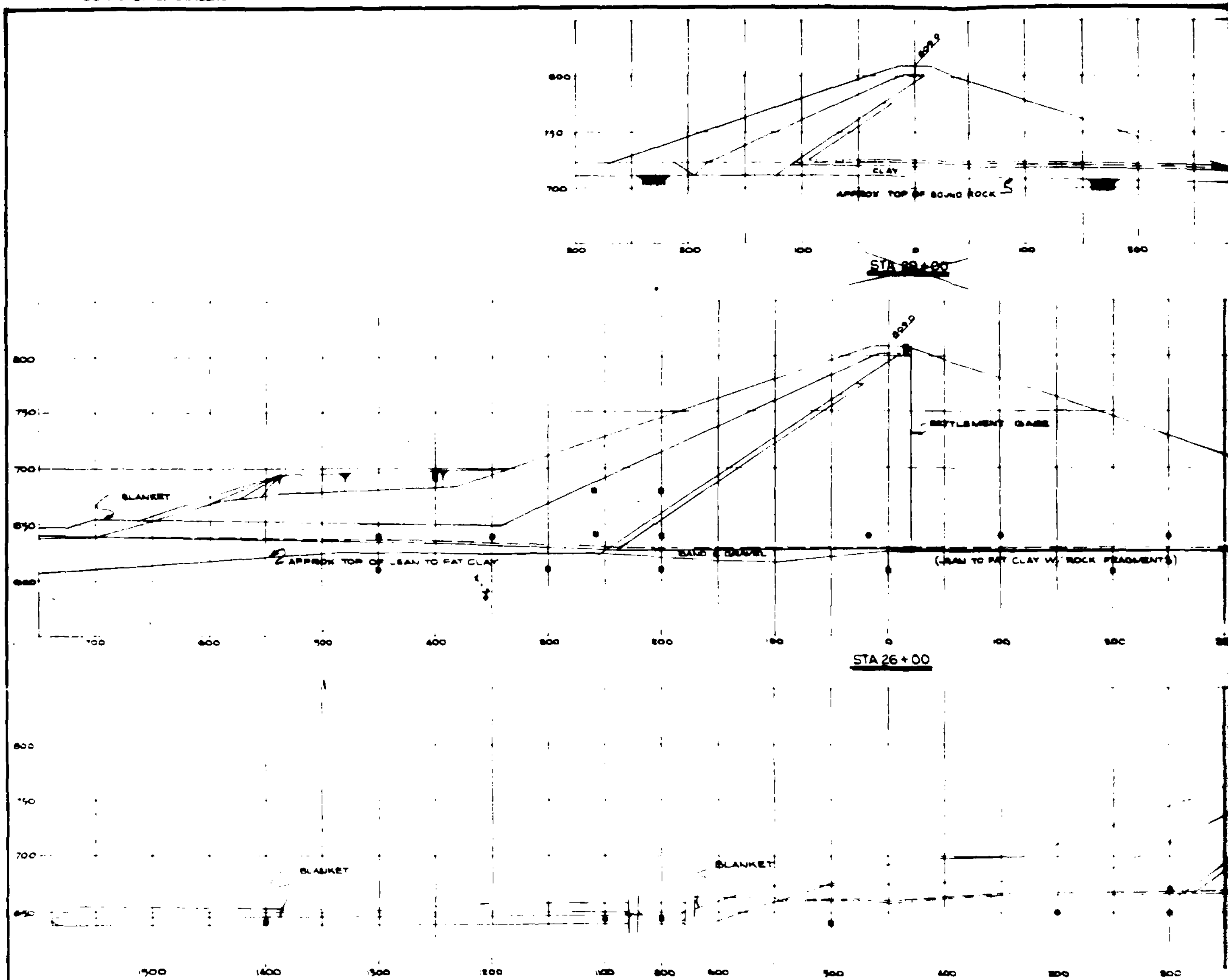
EFW-2 2-12 3/26

RECORD DRAWING "AS BUILT"

1

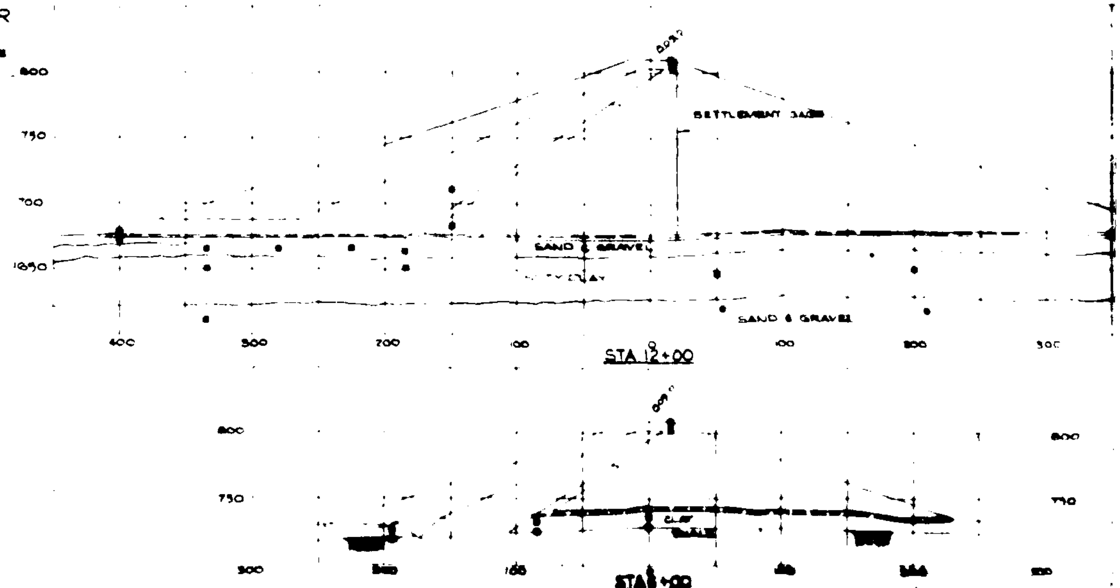
2

CORPS OF ENGINEERS

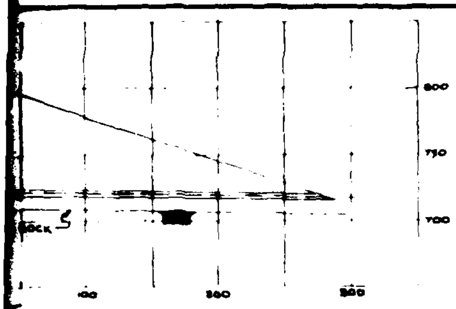


EMBANKMENT PIEZOMETER

DAM STATION # 5	RANGE (1)	TIP ELEVATION	TYPE
12+00	50 US	710	
↓	150 US	680	
↓	225 US	669	
12+00	260 US	669	
21+00	200 US	669	
26+00	00 DS	645	C
↓	250 DS	645	C
	5 US	645	C
	200 US	680	
	200 US	640	
	260 US	680	
	260 US	640	
↓	350 US	640	
26+00	450 US	640	



U.S. ARMY



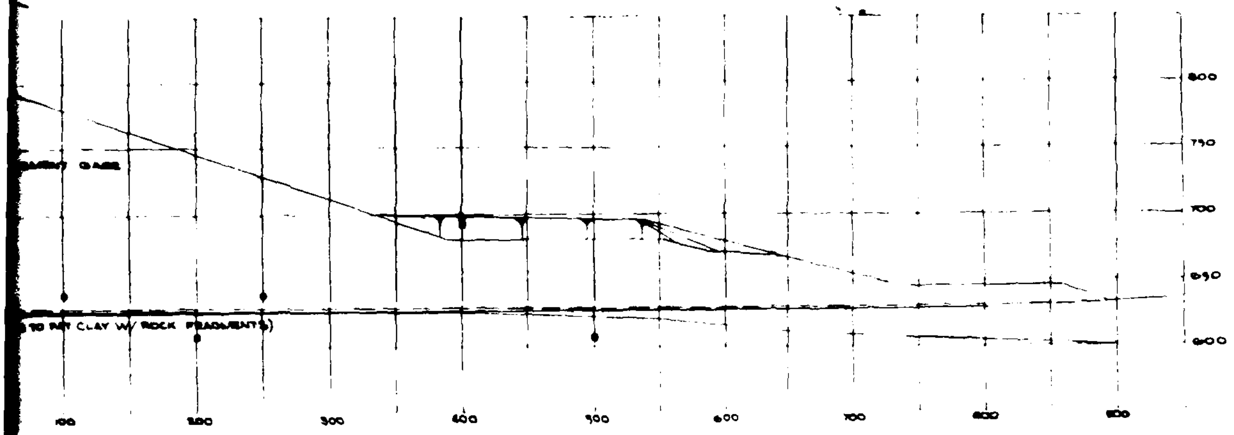
MOVEMENT MONUMENTS

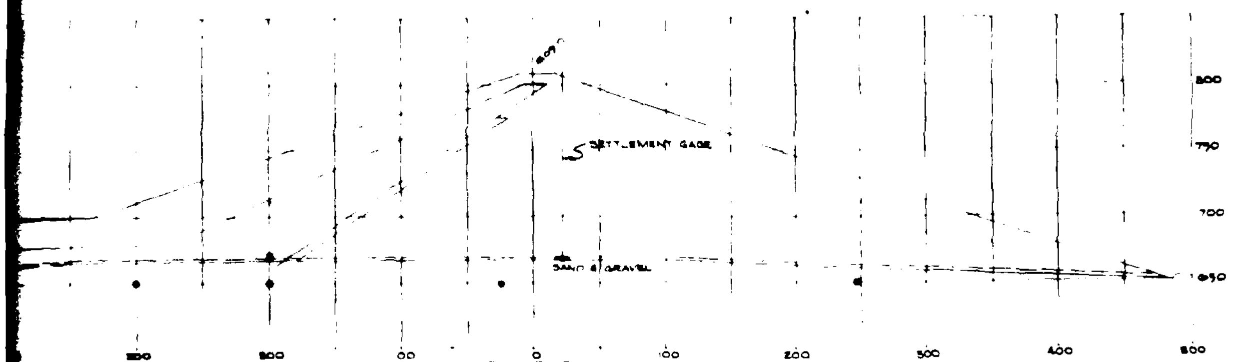
DAM STATION	400 FT US	15 FT DS	400 FT DS
* 2+50	x	x	x
4+00		x	
6+00		x	
8+00	x	x	x
10+00	x	x	x
12+00	x	x	x
14+00	x	x	x
16+00	x	x	x
18+00	x	x	x
20+00	x	x	x
22+00	x	x	x
24+00	x	x	x
26+00	x	x	x
28+00	x	x	x
30+00		x	
* 32+25	x		x
* 32+60		x	

* REFERENCE MONUMENTS

SETTLEMENT PLATE

DAM STATION	OFFSET
12+00	20 DS
21+00	20 DS
24+00	20 DS





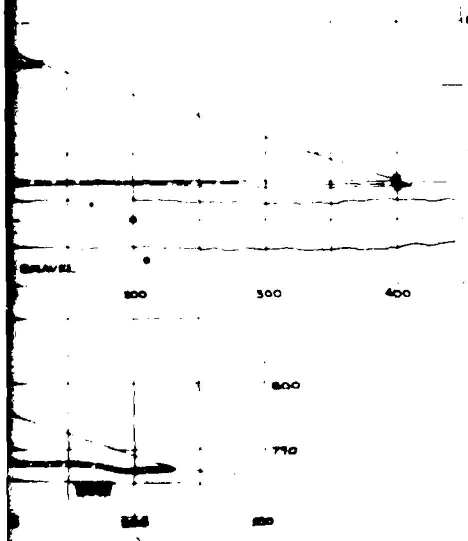
STA 21+00

FOUNDATION PIEZOMETER

DAM STATION	RANGE	* STRATUM LOCATION	TYPE
6+00	℄	CLAY	[illegible]
	℄	AT SHALE CONTACT	[illegible]
	85 US	CLAY	[illegible]
	85 US	CLAY SHALE CONTACT	A
	195 US	CLAY	A
6+00	195 US	CLAY SHALE CONTACT	A
12+00	50 DS	CLAY	A
	55 DS	LOWER S&G	C
	200 DS	CLAY	A
	250 DS	LOWER S&G	C
	165 US	UPPER S&G	A
	165 US	CLAY	A
	355 US	UPPER S&G	A
	355 US	CLAY	A
2+00	355 US	LOWER S&G	A
2+00	25 US	S&G	C
	249 US	S&G	A
	500 US	S&G	A
	800 US	BLANKET	A
	00 US	BLANKET	A
	400 US	BLANKET	A
	200 US	S&G	A
21+00	800 US	S&G	A
26+00	500 DS	CLAY	A
	℄	CLAY	A
	200 US	CLAY	A
	300 US	CLAY	A
	450 US	CLAY	A
[illegible]	300 DS	CLAY	A

PIEZ TYPE A ADDED

STA 6+25	350 LT
20+25	350 LT
22+00	60
24+00	200 LT



- A - CASAGRANDE TYPE PIEZOMETERS
- A - [illegible] PIEZOMETERS
- * EXACT ELEVATION OF TIP TO BE DETERMINED BY PILOT BORINGS TIP SHALL BE LOCATED AS CLOSE AS PRACTICABLE TO THOSE SHOWN ON CROSS SECTIONS

REVISION	DATE	DESCRIPTION	BY

U S ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

DESIGNED
DRAWN D P H   TRACED G T B.
CHECKED
SUBMITTED
APPROVAL RECOM

OHIO RIVER BASIN
BROOKVILLE RESERVOIR
EAST FORK WHITEWATER RIVER, INDIANA
DAM
PIEZOMETER INSTALLATION

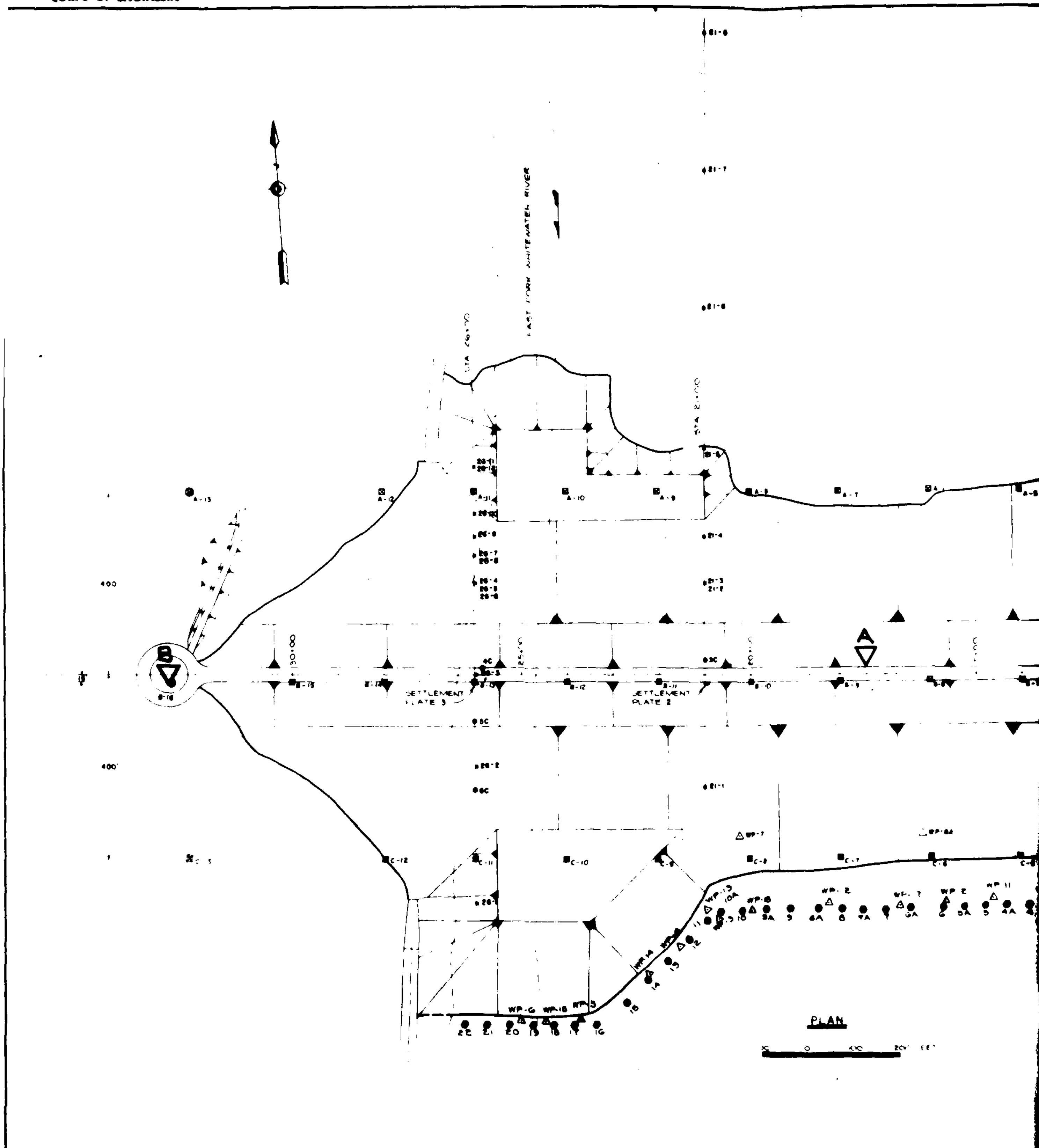
APPROVED   DATE
SCALE
DRAWING NUMBER
EFW-22-123/29

PLATE NO. 20

RECORD DRAWING, AS BUILT

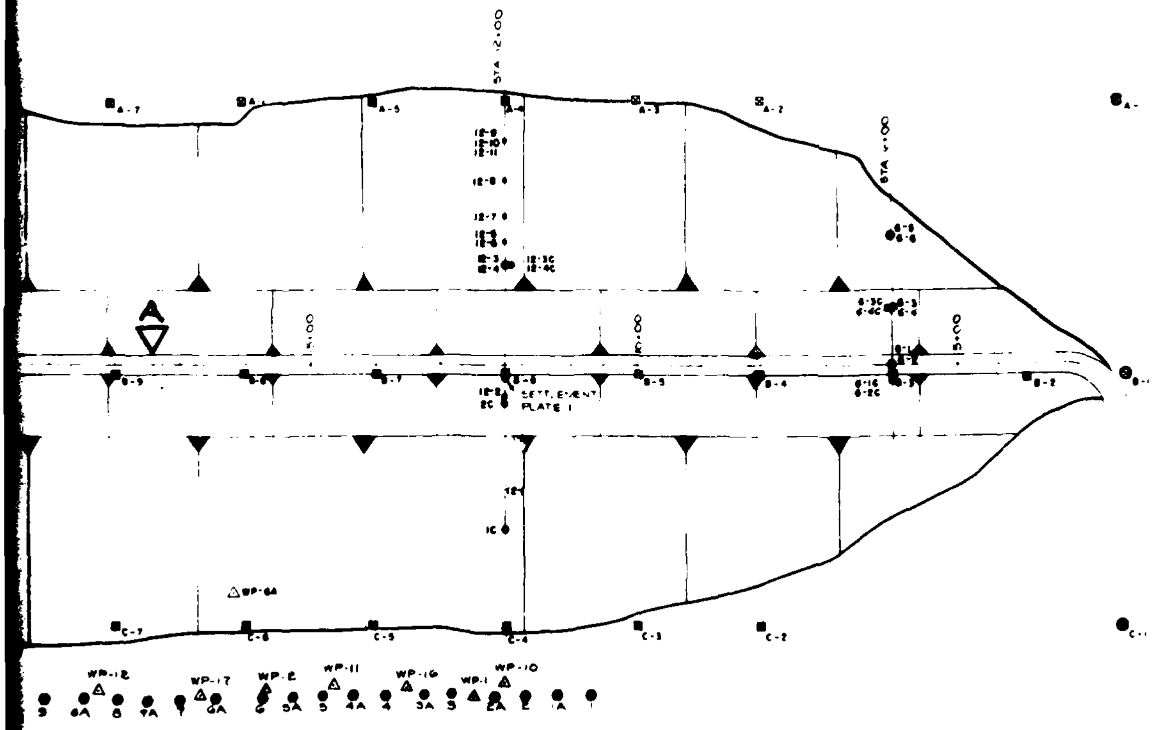
2

CORPS OF ENGINEERS



SEISMIC INST
LOCATED BY
PARKING AR

U. S. ARMY



PLAN

0 100 200 FEET

LEGEND

- GAS ACTUATED PIEZOMETERS
- CASAGRANDE TYPE PIEZOMETERS
- MOVEMENT MONUMENTS
- REFERENCE MONUMENTS
- WELL POINT TYPE PIEZOMETERS
- SETTLEMENT PLATES
- RELIEF WELLS
- INOPERATIVE GAS ACTUATED PIEZOMETER

▽ SEISMIC INSTRUMENTS

SEISMIC INSTRUMENT "C" IS LOCATED BY THE TAILWATER PARKING AREA

REVISION	DATE	DESCRIPTION	BY

U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

DRAWN: K L H | TRACED: K L H

OHIO RIVER BASIN
BROOKVILLE RESERVOIR
EAST FORK WHITEWATER RIVER, INDIANA
DAM
INSTRUMENTATION PLAN

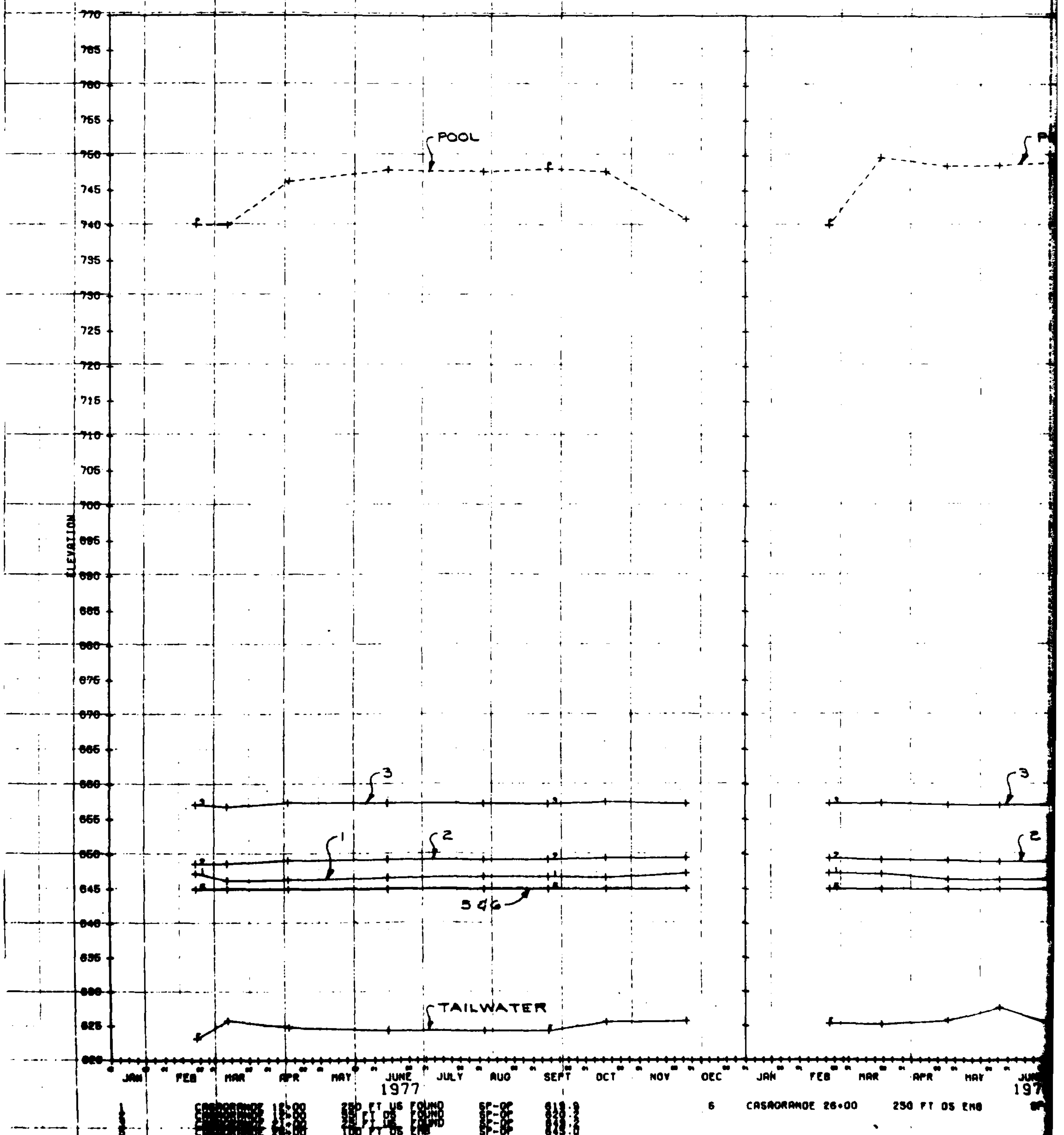
SCALE | DATE

DRAWING NUMBER

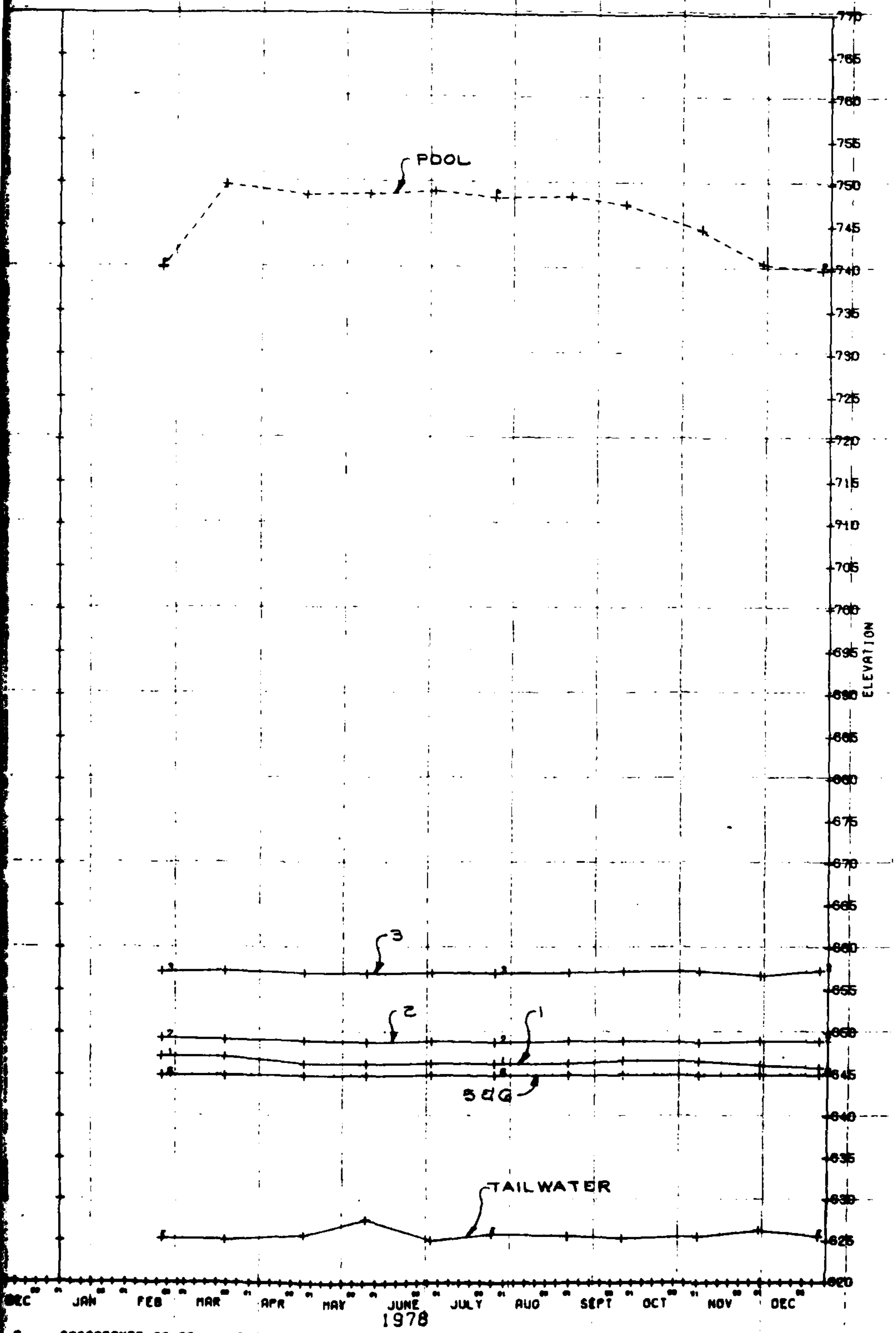
2

PLATE NO. [illegible]

BROOKVILLE CASAGRANDE PIEZOMETERS



RANDE PIEZOMETERS

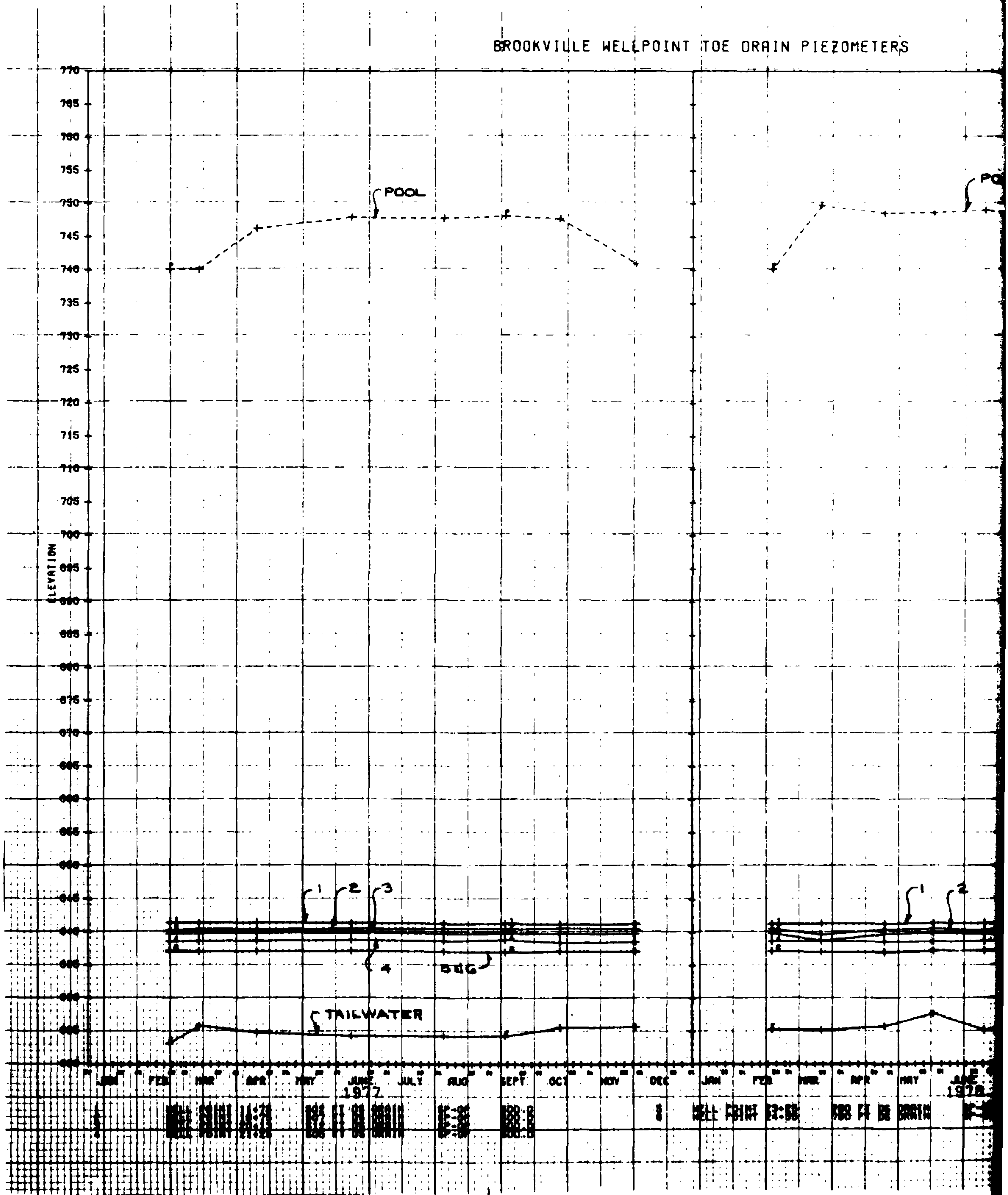


8 CASAGRANDE 26+00 250 FT DS EMB SP-OP 645.0

PLATE NO. 22

2

1



BROOKVILLE WELLPOINT TOE DRAIN PIEZOMETERS
770
765
760
755
750
745
740
735
730
725
720
715
710
705
700
ELEVATION
POOL
1
2
3
4
5&6
TAILWATER
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1977
1978

TOE DRAIN PIEZOMETERS

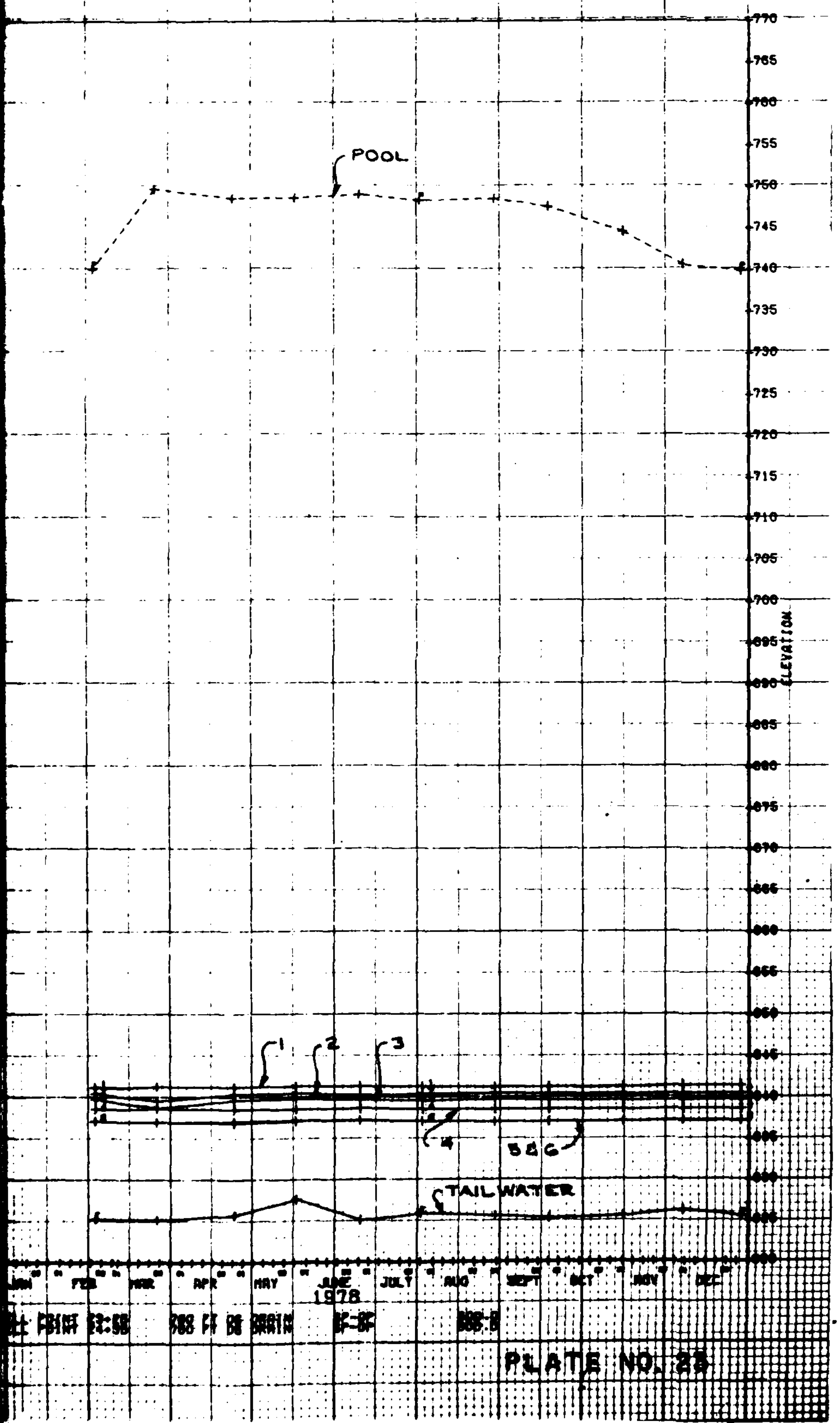
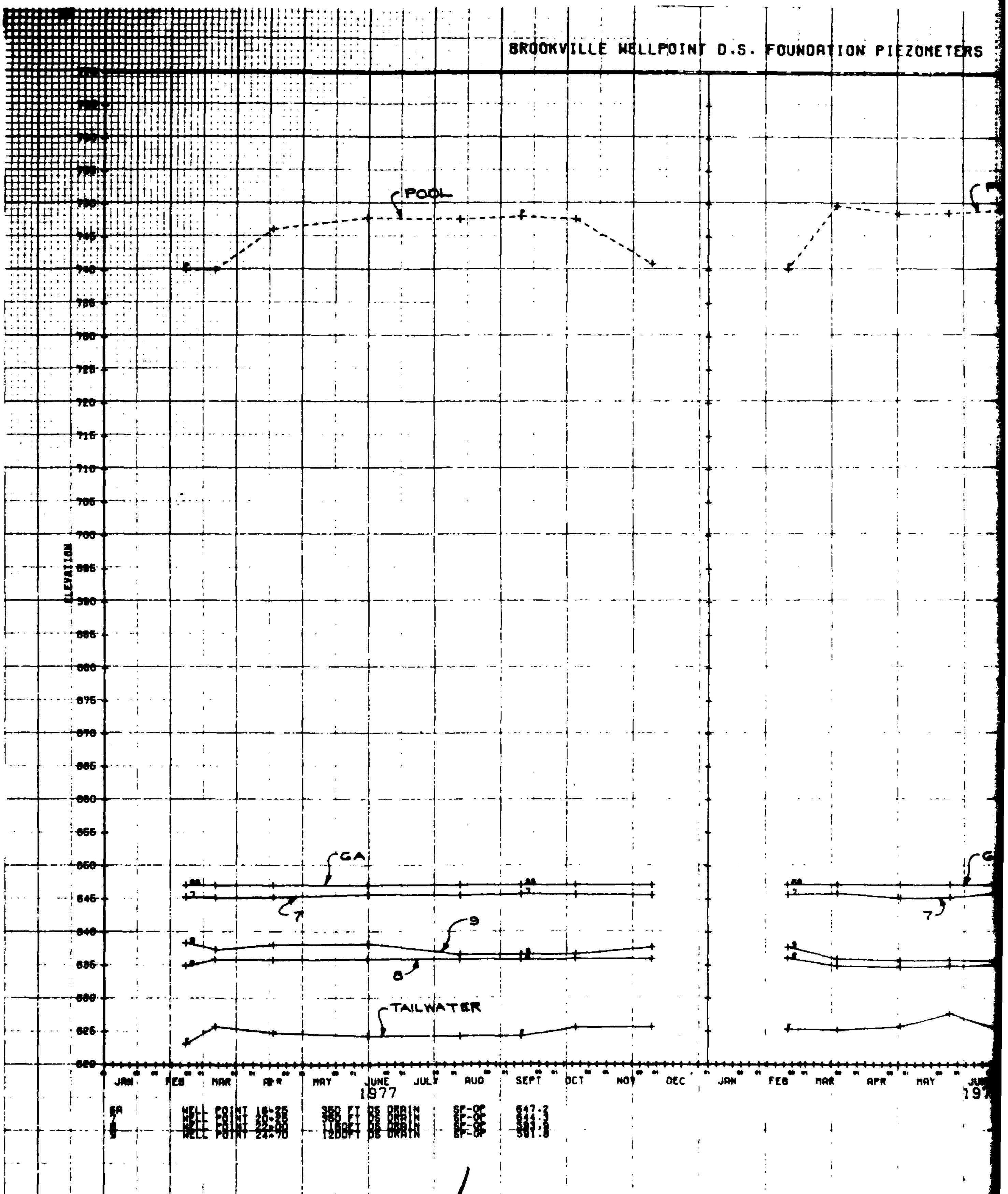


PLATE NO. 25


BROOKVILLE WELLPOINT D.S. FOUNDATION PIEZOMETERS
ELEVATION
POOL
6A
7
9
8
TAILWATER
JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY
1977
6A WELL POINT 16+25 350 FT DS DRAIN SP-OP 647.2
9 WELL POINT 24+70 1200FT DS DRAIN SP-OP 591.8

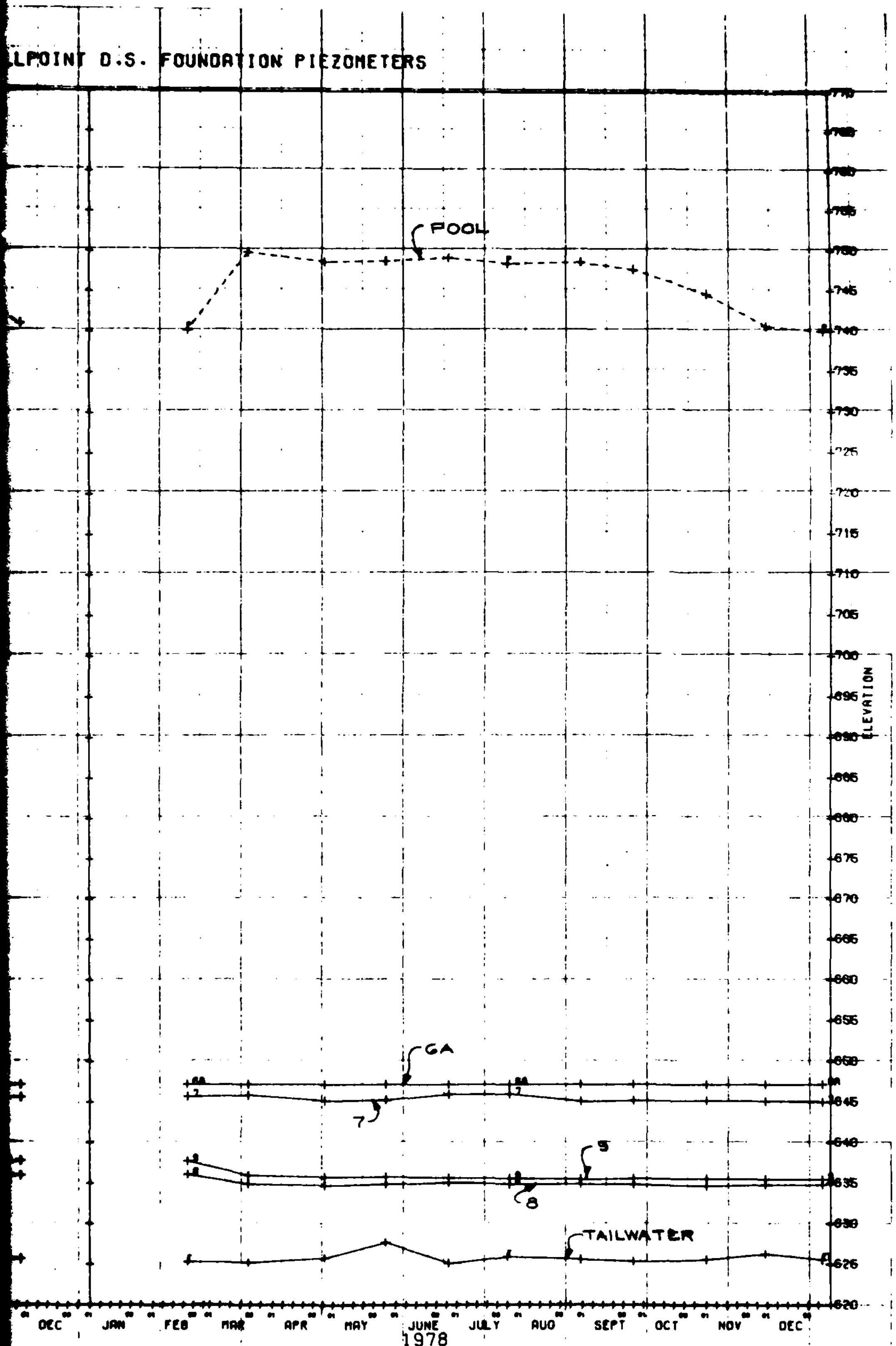
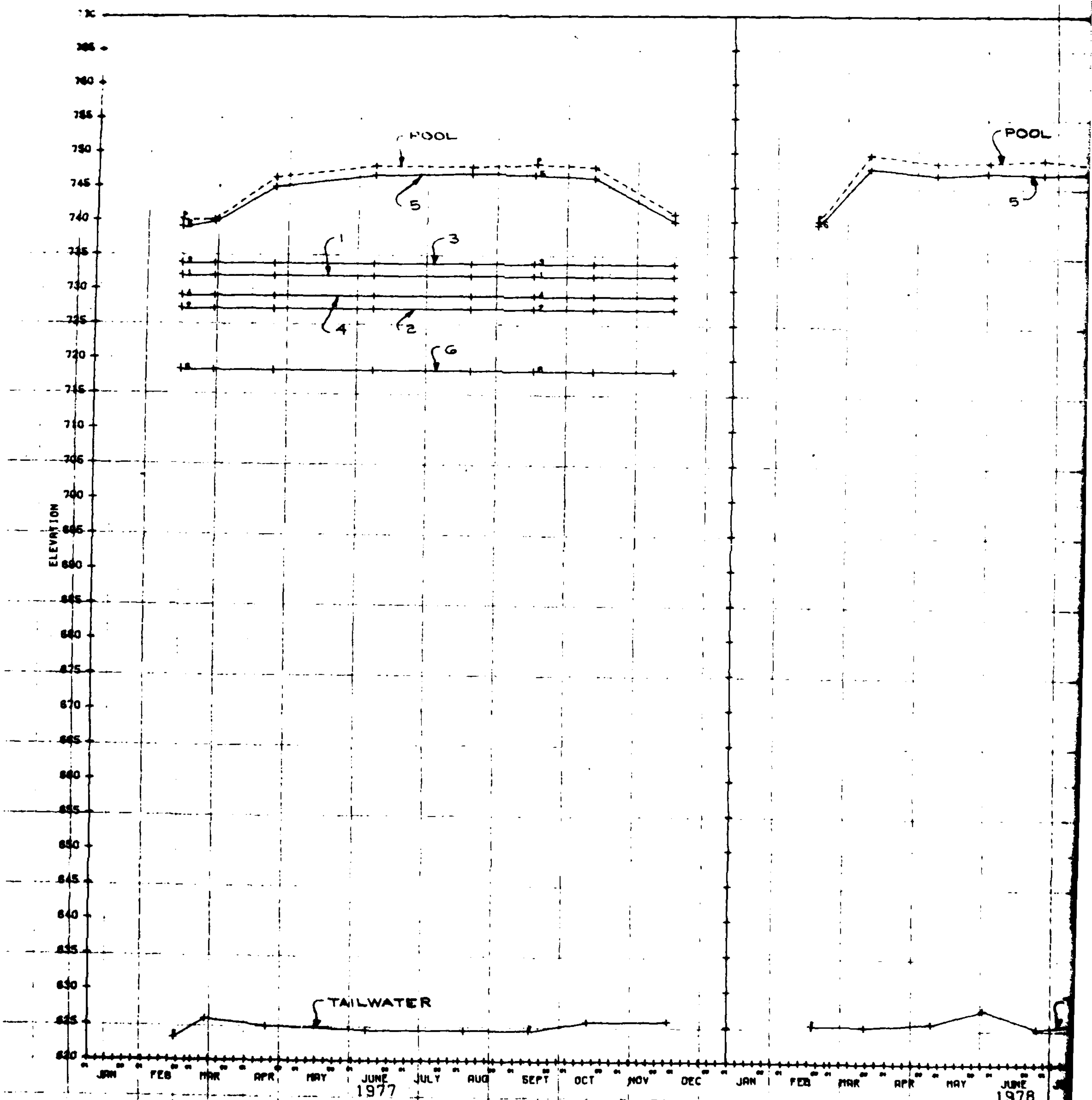


PLATE NO. 24

2

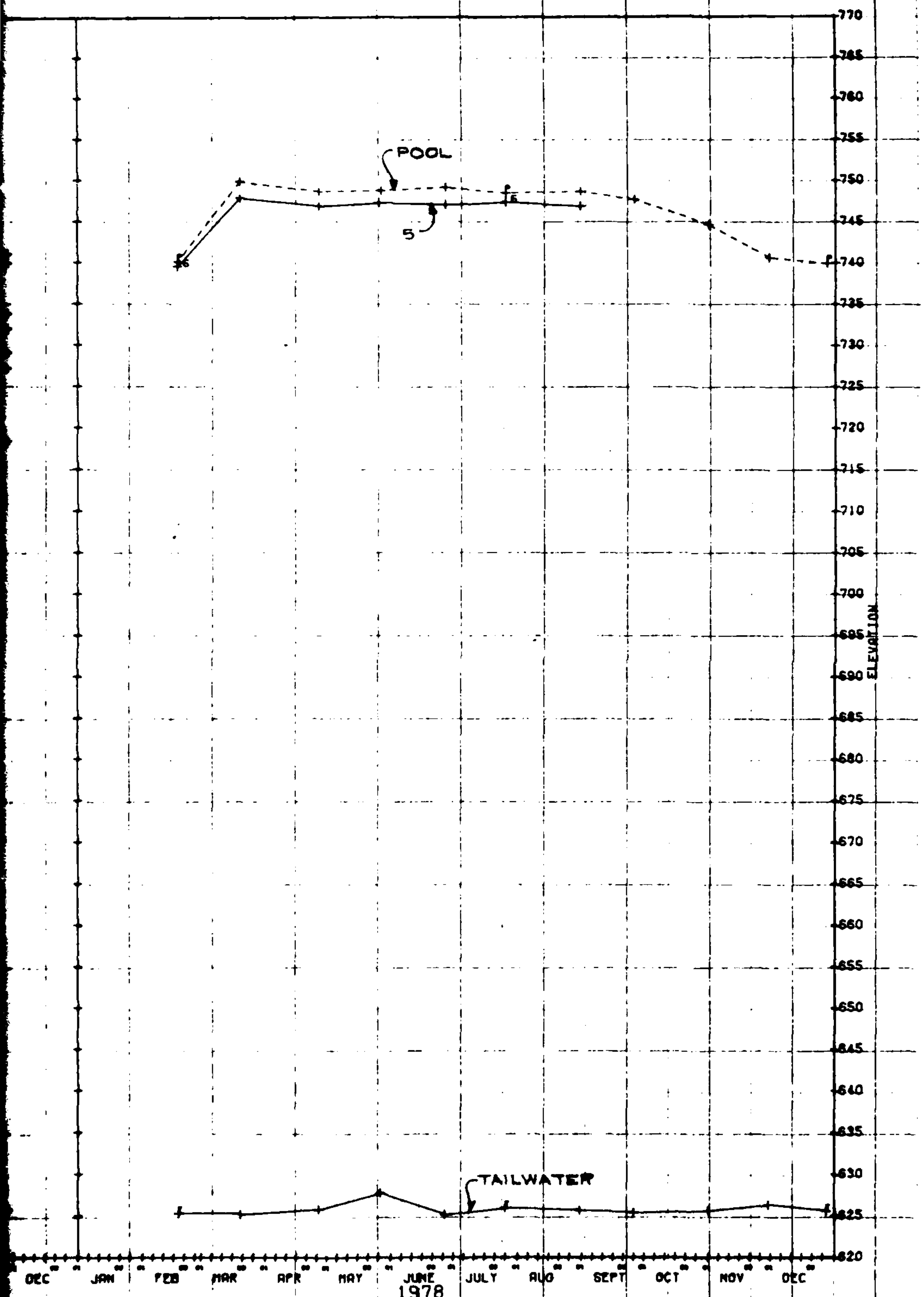
55

BROOKVILLE U.S. FOUND PIEZ. STA 6+00



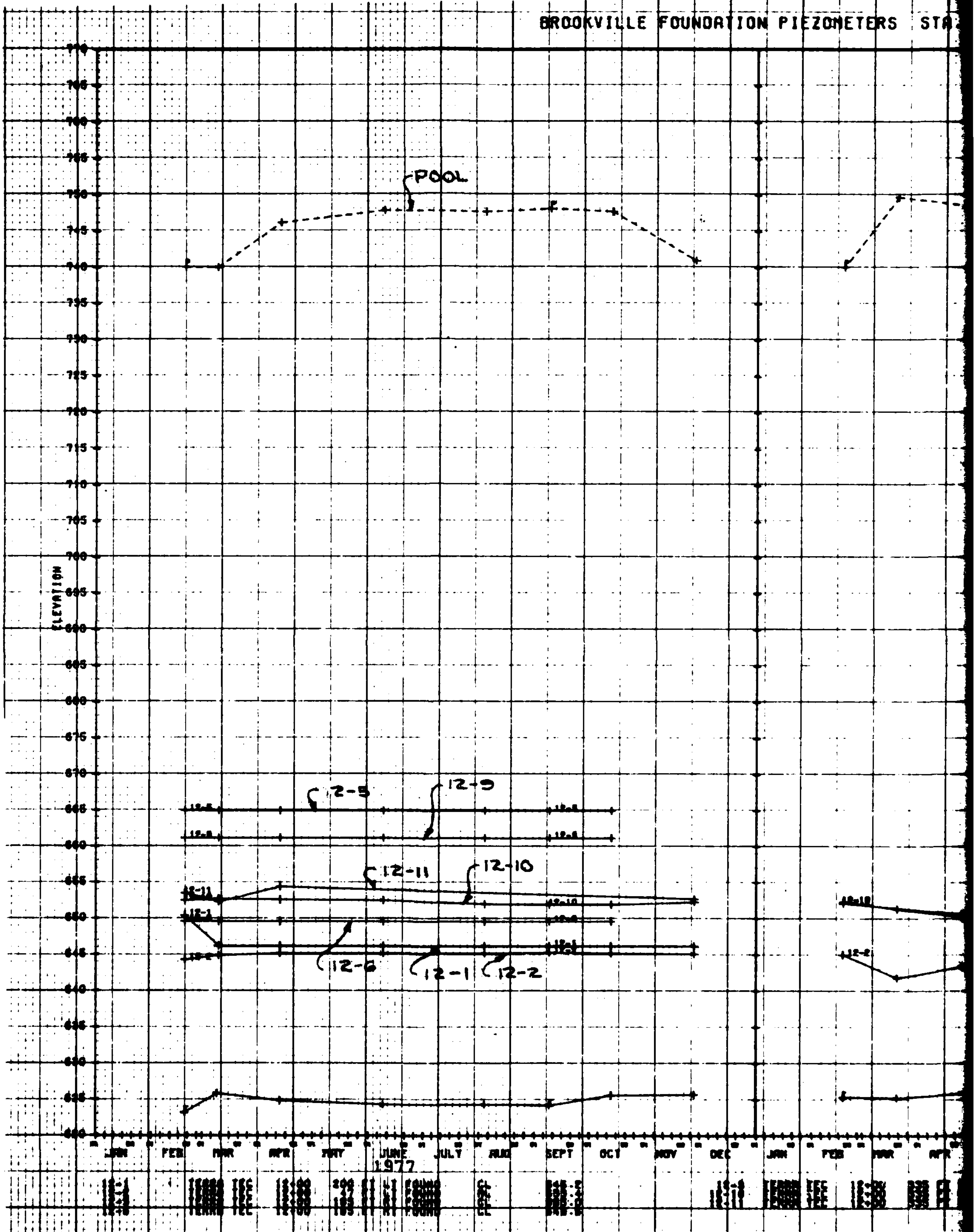
1	TERRA TEC	6+00	CENTERLINE FOUND	CL	731.9
2	TERRA TEC	6+00	CENTERLINE FOUND	CL-6M	727.1
3	TERRA TEC	6+00	85 FT US FOUND	CL	733.7
4	TERRA TEC	6+00	85 FT US FOUND	CL-6M	729.0
5	TERRA TEC	6+00	195 FT US FOUND	CL	
6	TERRA TEC	6+00	195 FT US FOUND	CL-6M	

FOUND PIEZ. STA 6+00



5	TERRA TEC	6+00	195 FT US FOUND	EL	724.3
6	TERRA TEC	6+00	195 FT US FOUND	EL-6M	718.3

PLATE NO. 25



BROOKVILLE FOUNDATION PIEZOMETERS STA
POOL
12-5
12-9
12-11
12-10
12-6
12-1
12-2
ELEVATION
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
JAN
FEB
MAR
APR
1977

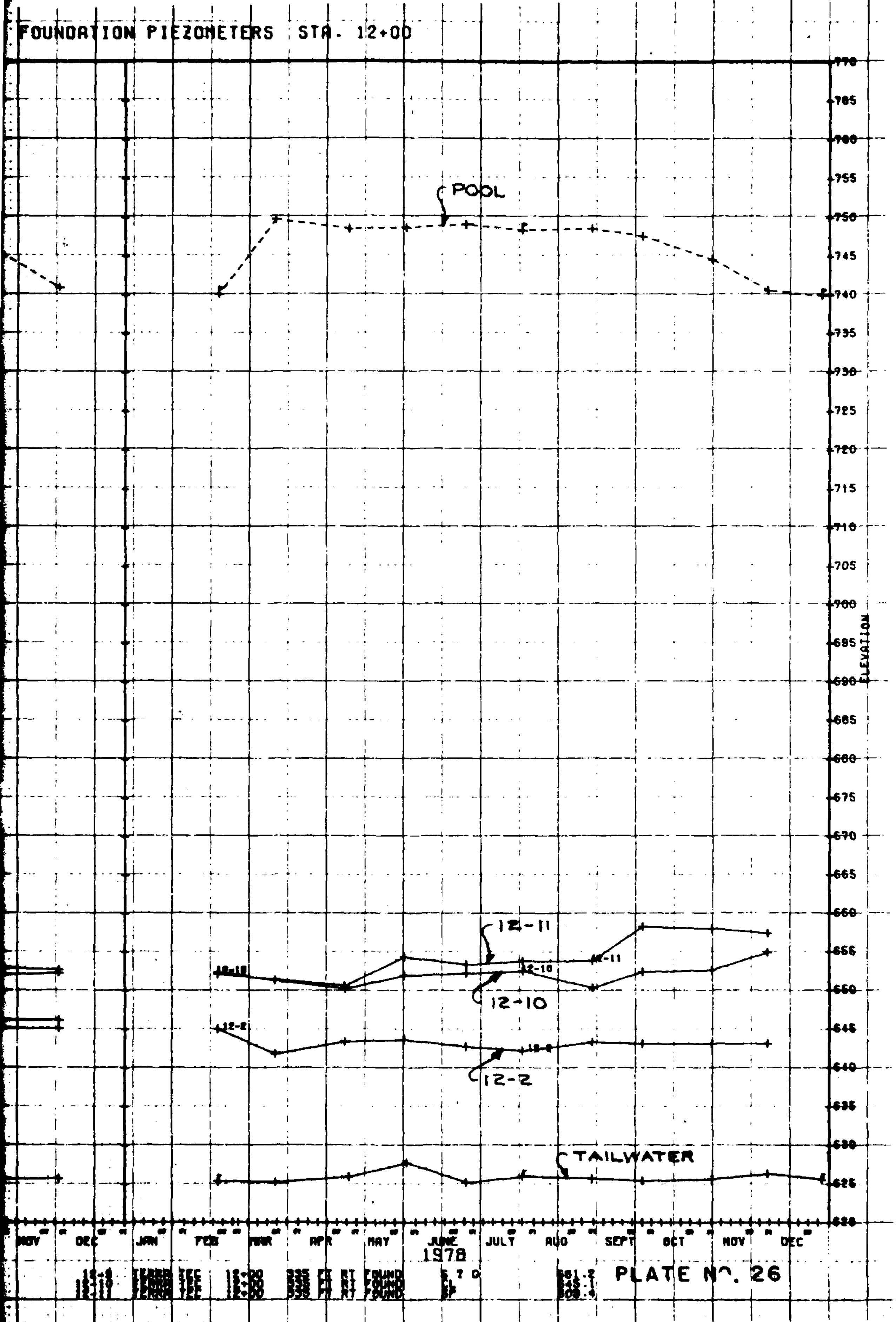
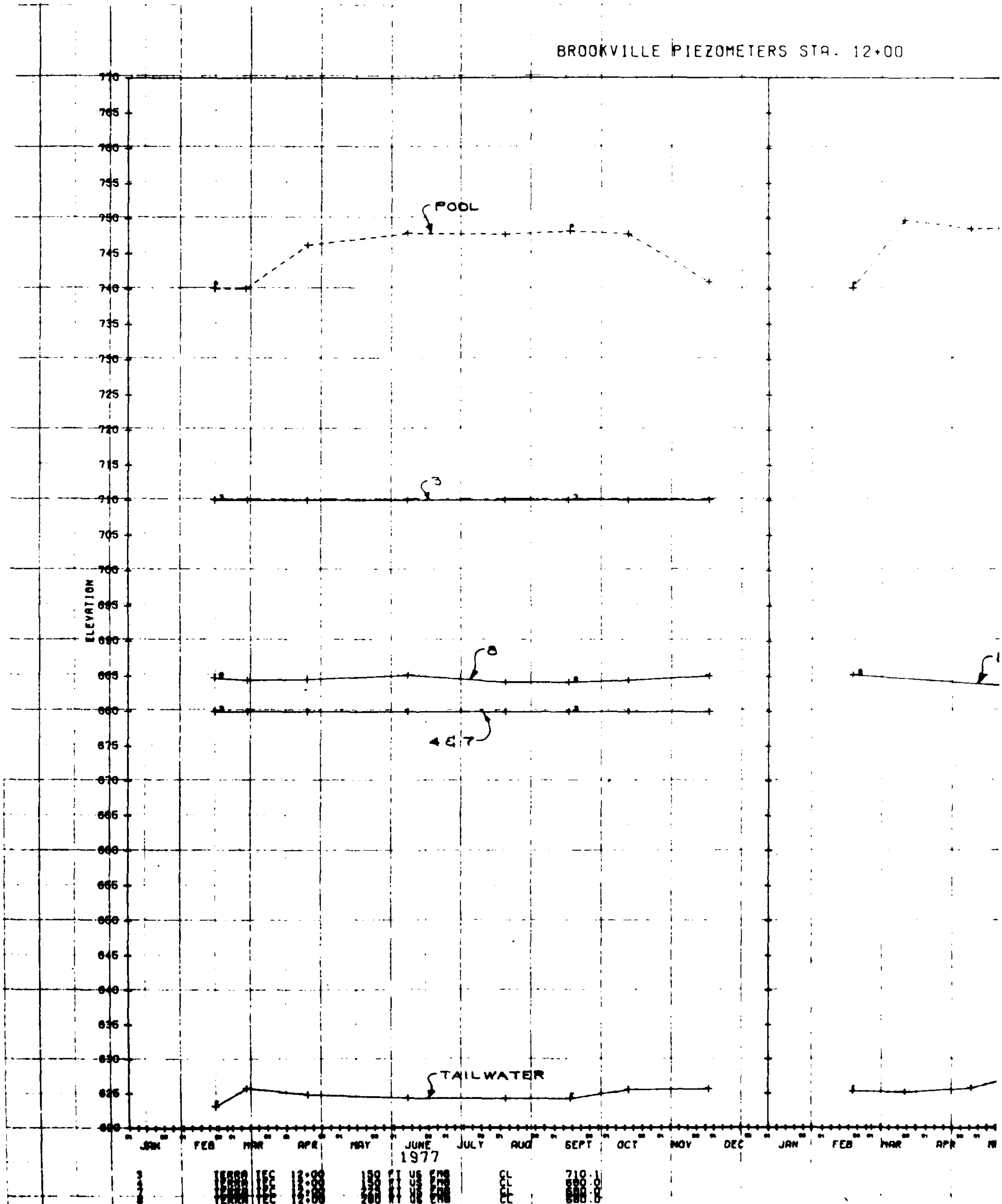


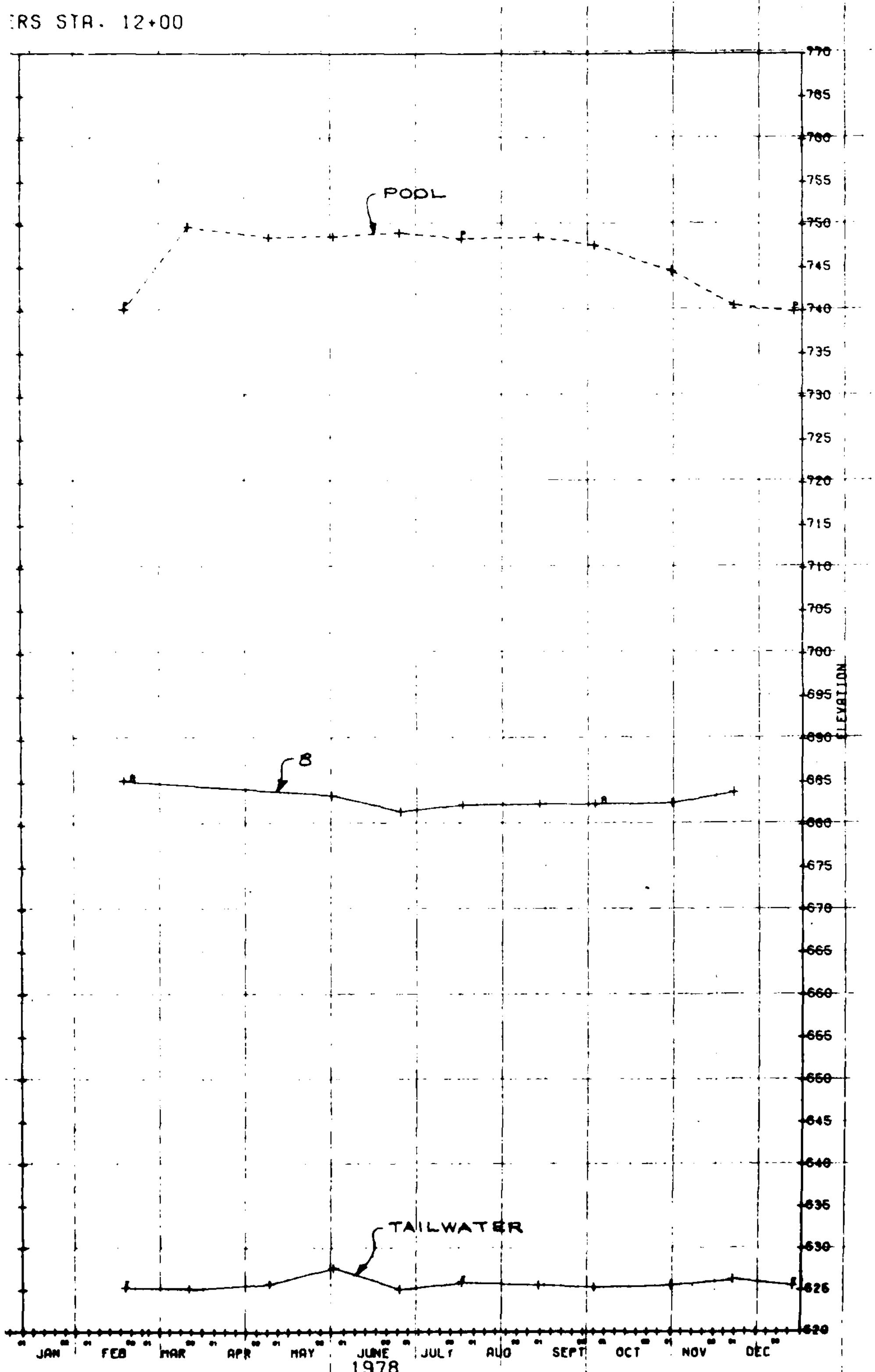
PLATE NO. 26

1

2



BROOKVILLE PIEZOMETERS STA. 12+00
ELEVATION
POOL
3
8
4 & 7
TAILWATER
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1977
3 TERRA TEC 12:00 150 FT US EMB CL 710.1



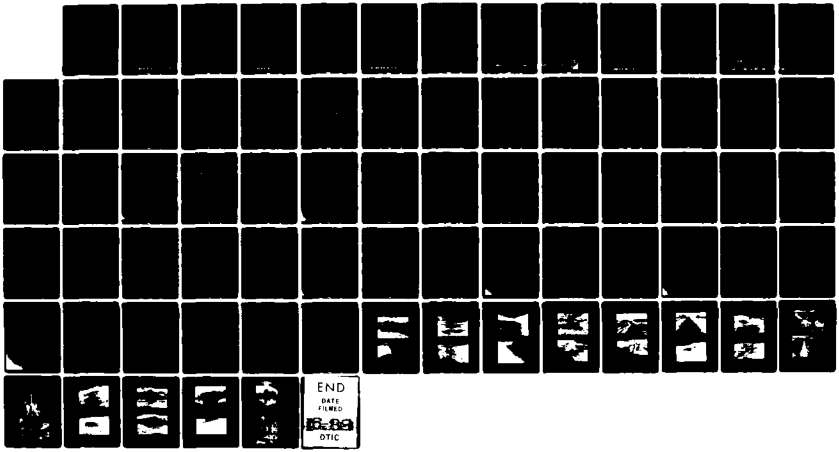
:RS STA. 12+00
POOL
8
TAILWATER
ELEVATION
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1978

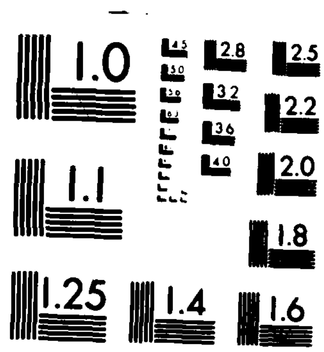
PLATE NO. 27

AD-A127 465 BROOKVILLE LAKE GREATER MIAMI RIVER BASIN INDIANA EMBANKMENT CRITERIA AND PERFORMANCE REPORT(U) ARMY ENGINEER DISTRICT LOUISVILLE KY SEP 82

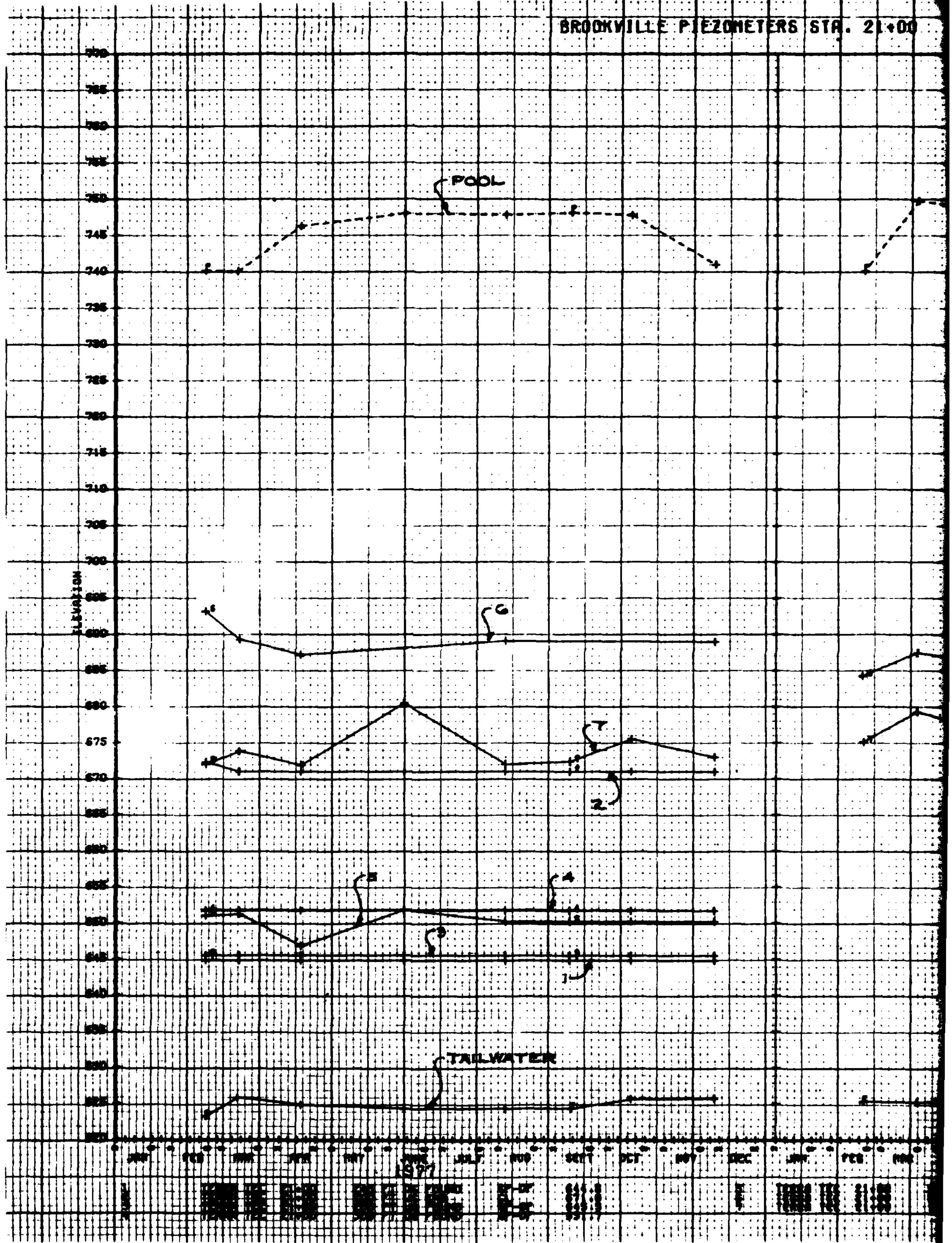
2/2

UNCLASSIFIED F/G 8/7 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A


BROOKVILLE PIEZOMETERS STA. 21+00
POOL
ELEVATION
6
7
2
5
4
3
1
TAILWATER
1977

E PIEZOMETERS STA. 21+00

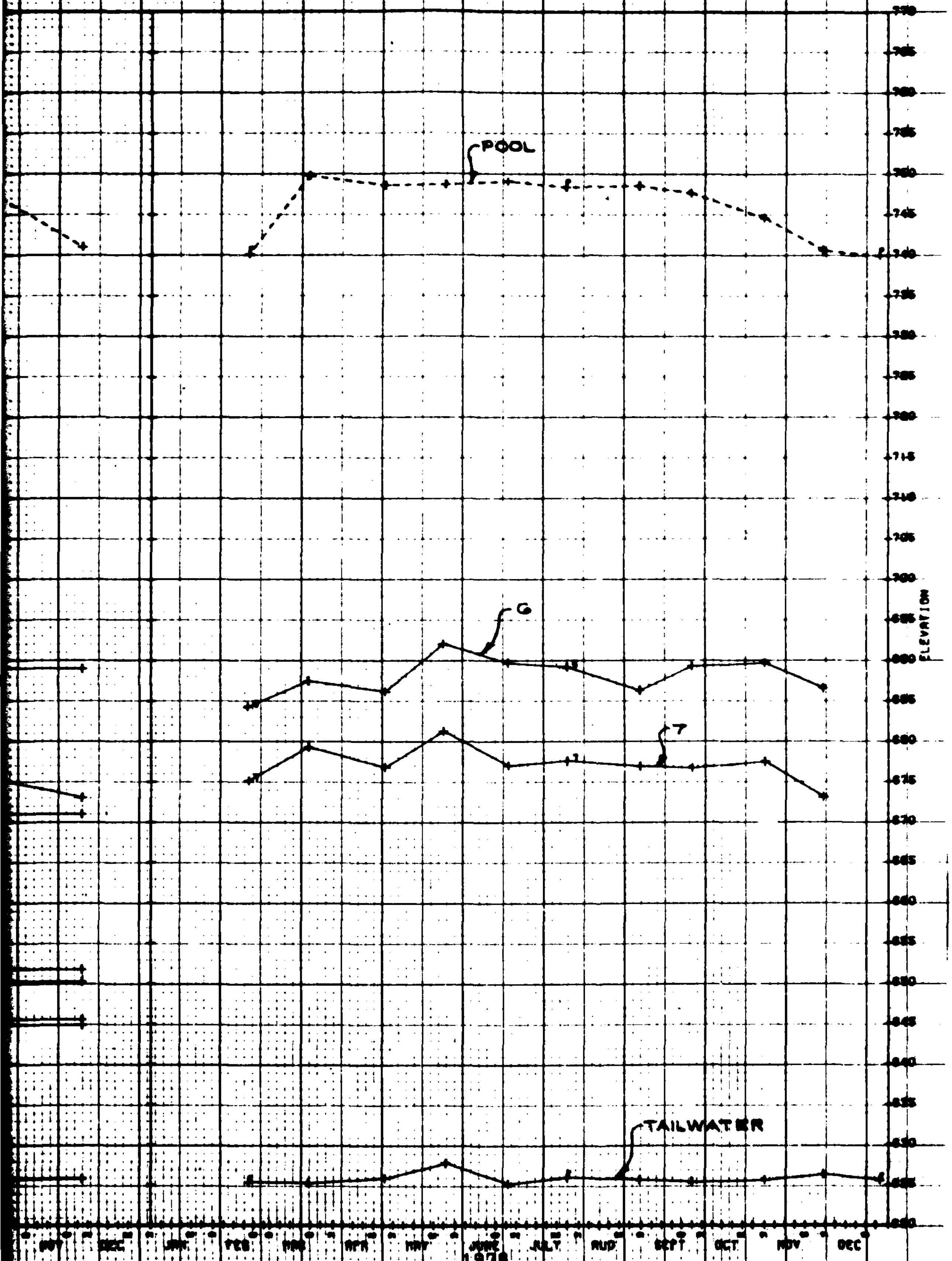
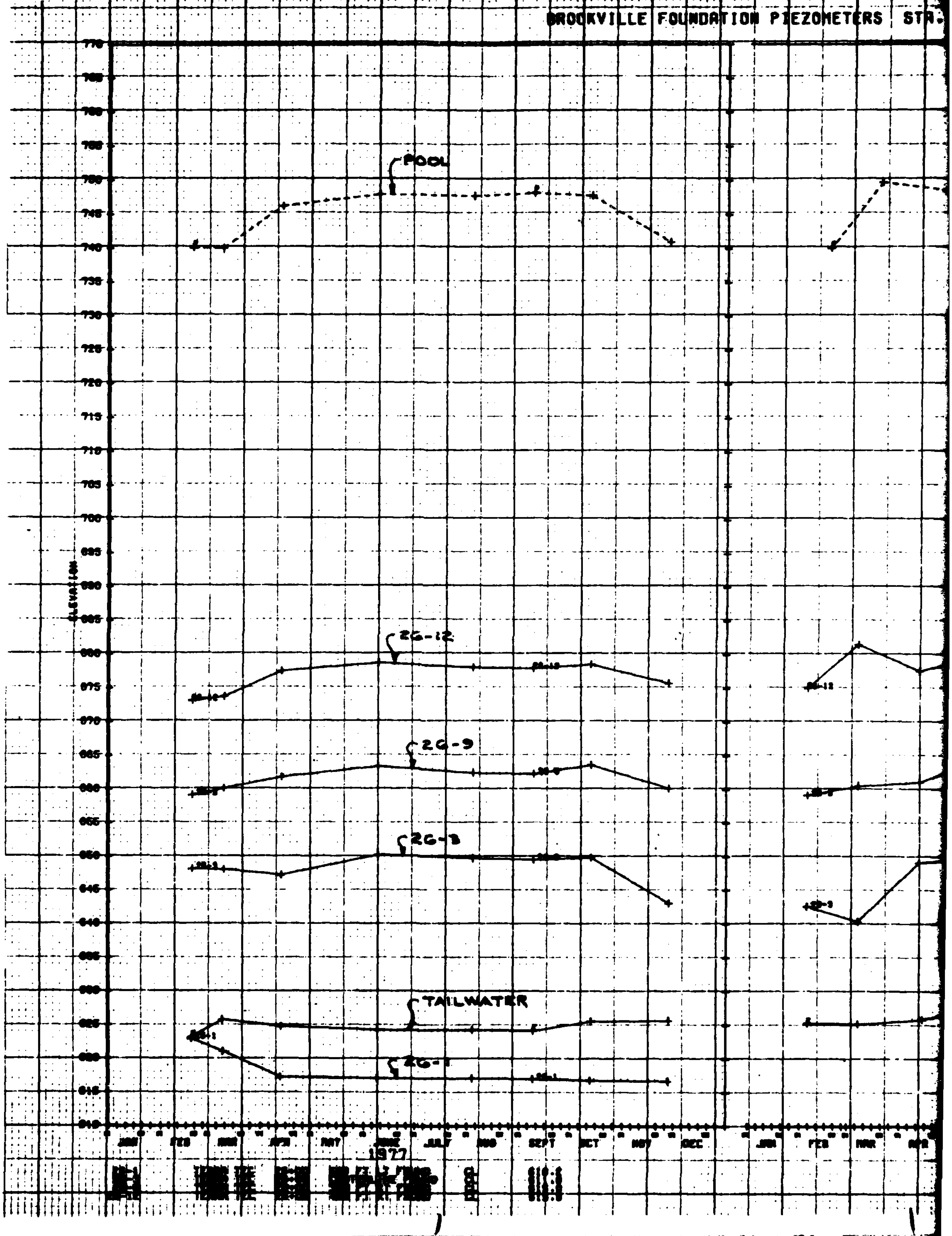
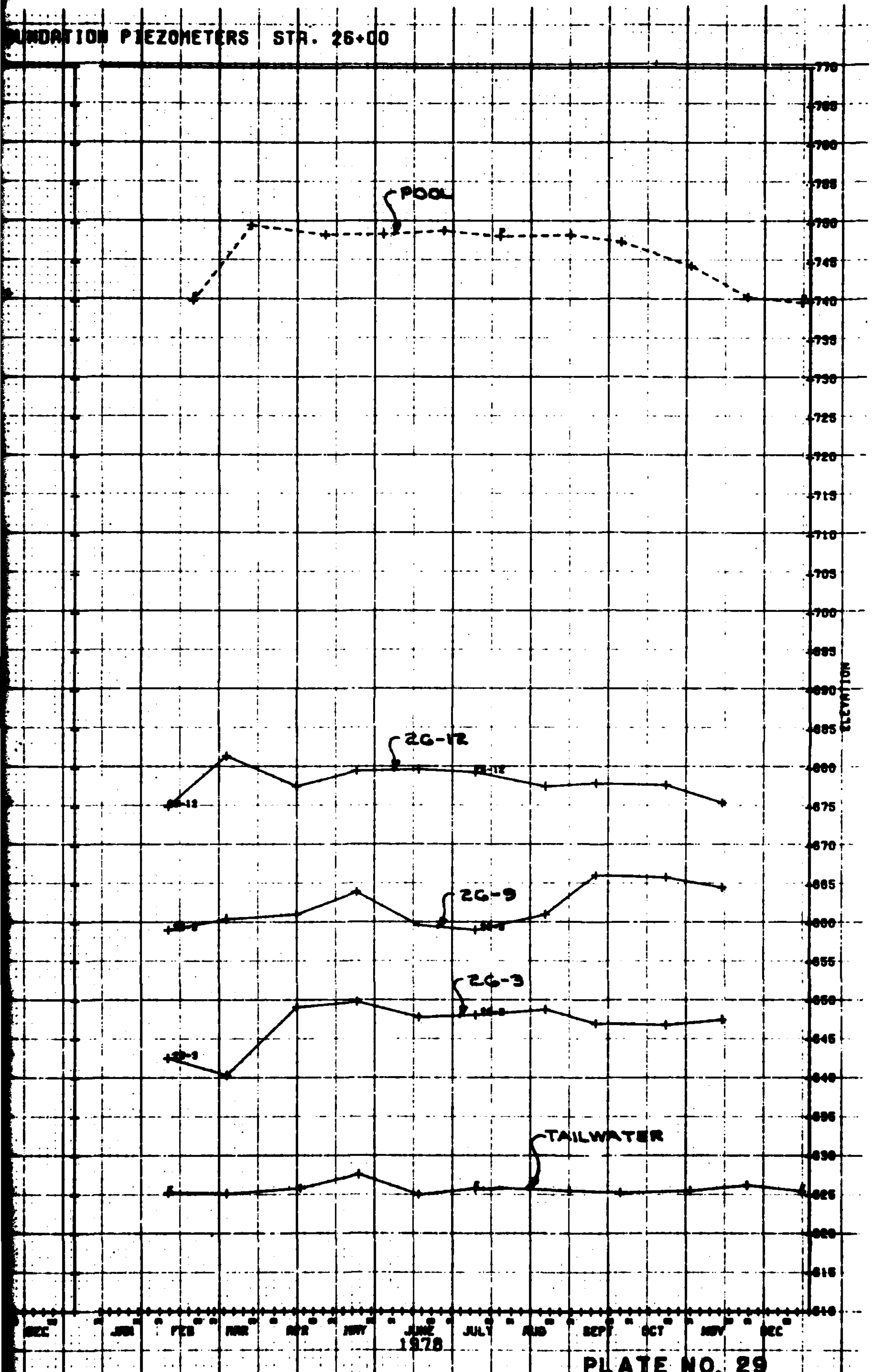


PLATE NO. 28

1 2

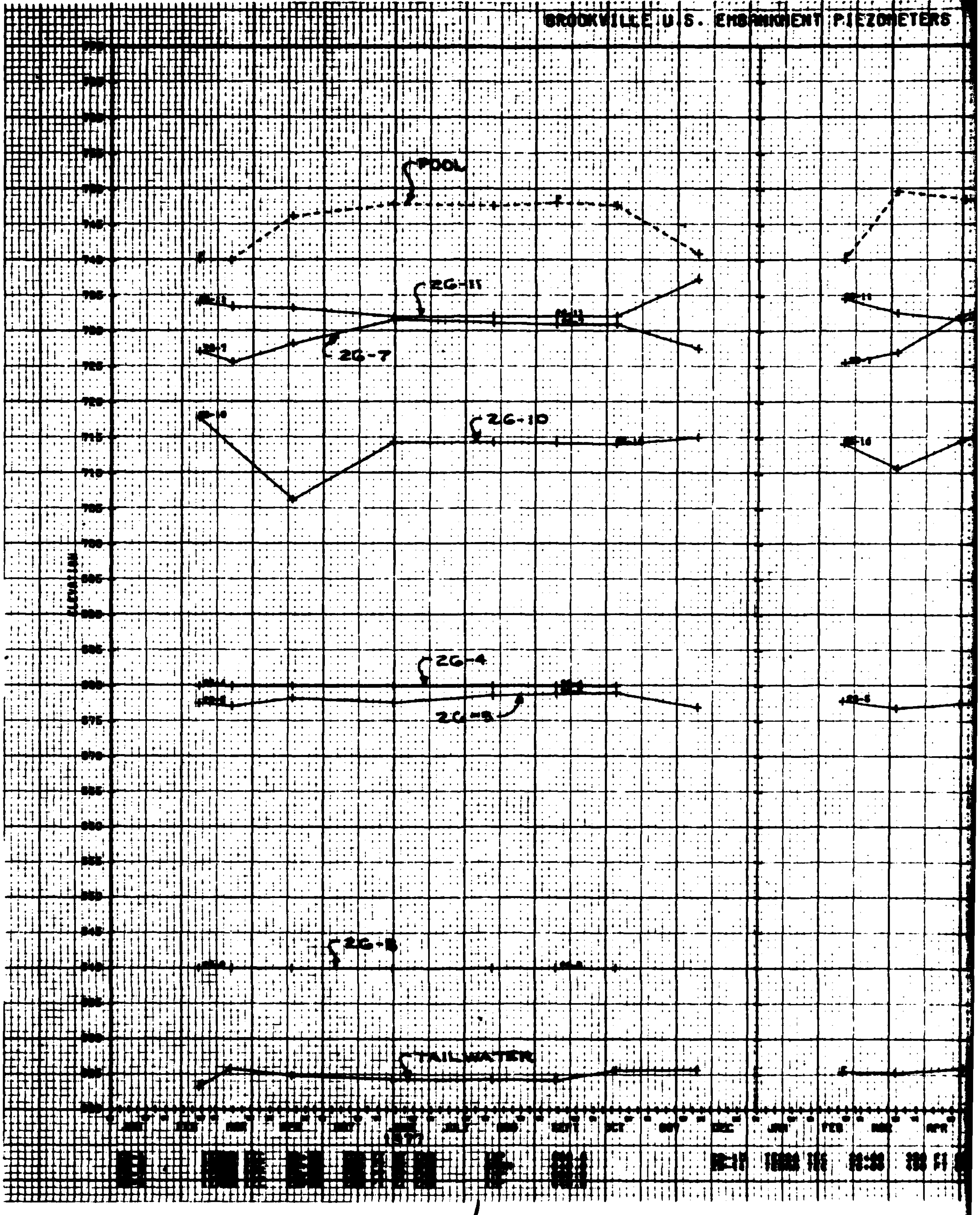


BROOKVILLE FOUNDATION PIEZOMETERS
ELEVATION
770
765
760
755
750
745
740
735
730
725
720
715
710
705
700
695
690
685
680
675
670
665
660
655
650
645
640
635
630
625
620
615
610
POOL
ZG-12
ZG-9
ZG-3
TAILWATER
ZG-1
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1977
JAN
FEB
MAR
APR



UNDATION PIEZOMETERS STA. 26+00
POOL
26-12
26-9
26-3
TAILWATER
ELEVATION
770
765
760
755
750
745
740
735
730
725
720
715
710
705
700
695
690
685
680
675
670
665
660
655
650
645
640
635
630
625
620
615
610
DEC
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1978

PLATE NO. 29


BROOKVILLE U.S. EMBANKMENT PIEZOMETERS
POOL
ZG-11
ZG-7
ZG-10
ELEVATION
ZG-4
ZG-5
ZG-8
TAILWATER
1977
OCT
DEC
JAN
FEB
APR

EMBANKMENT PIEZOMETERS STA. 26+00

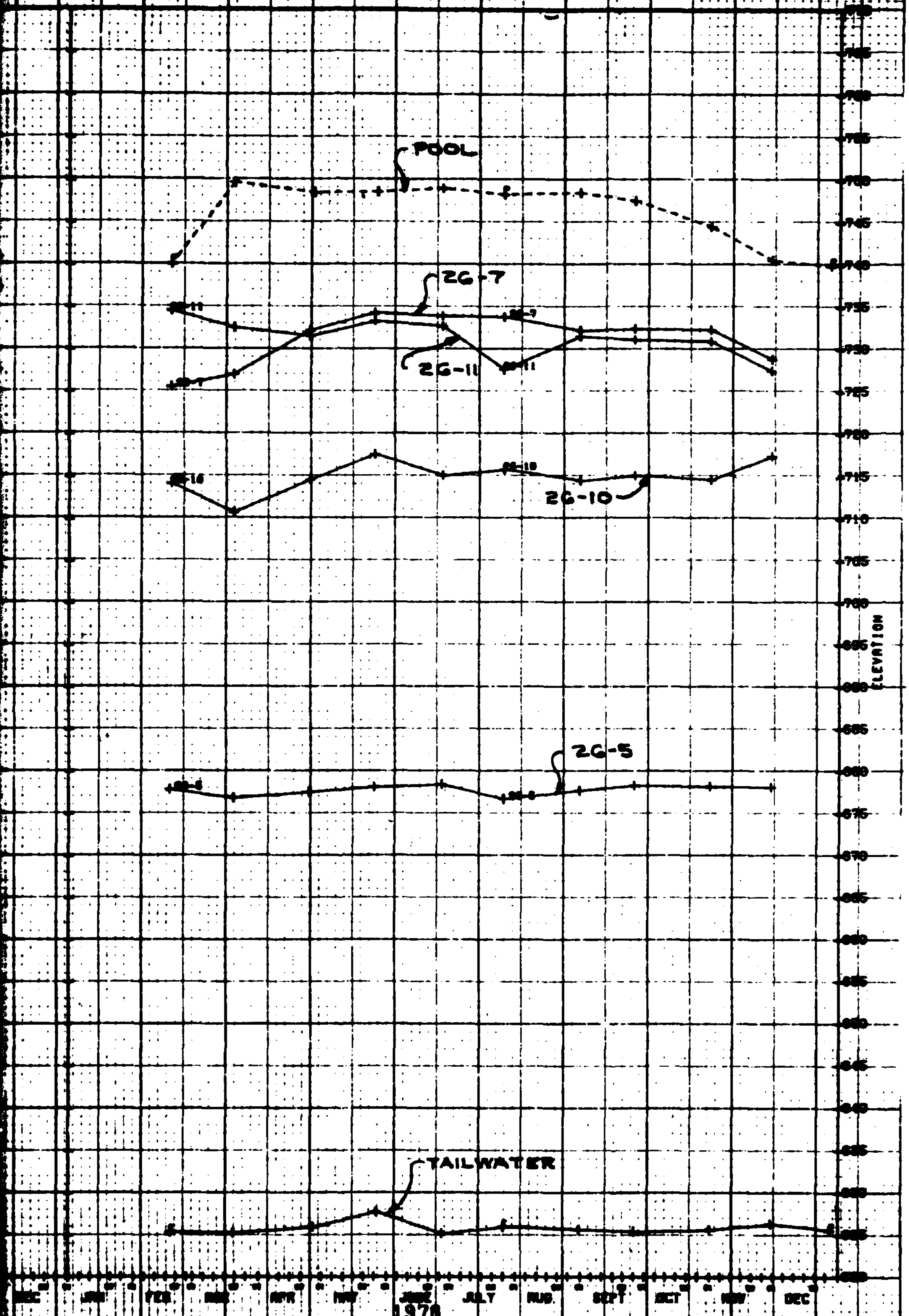
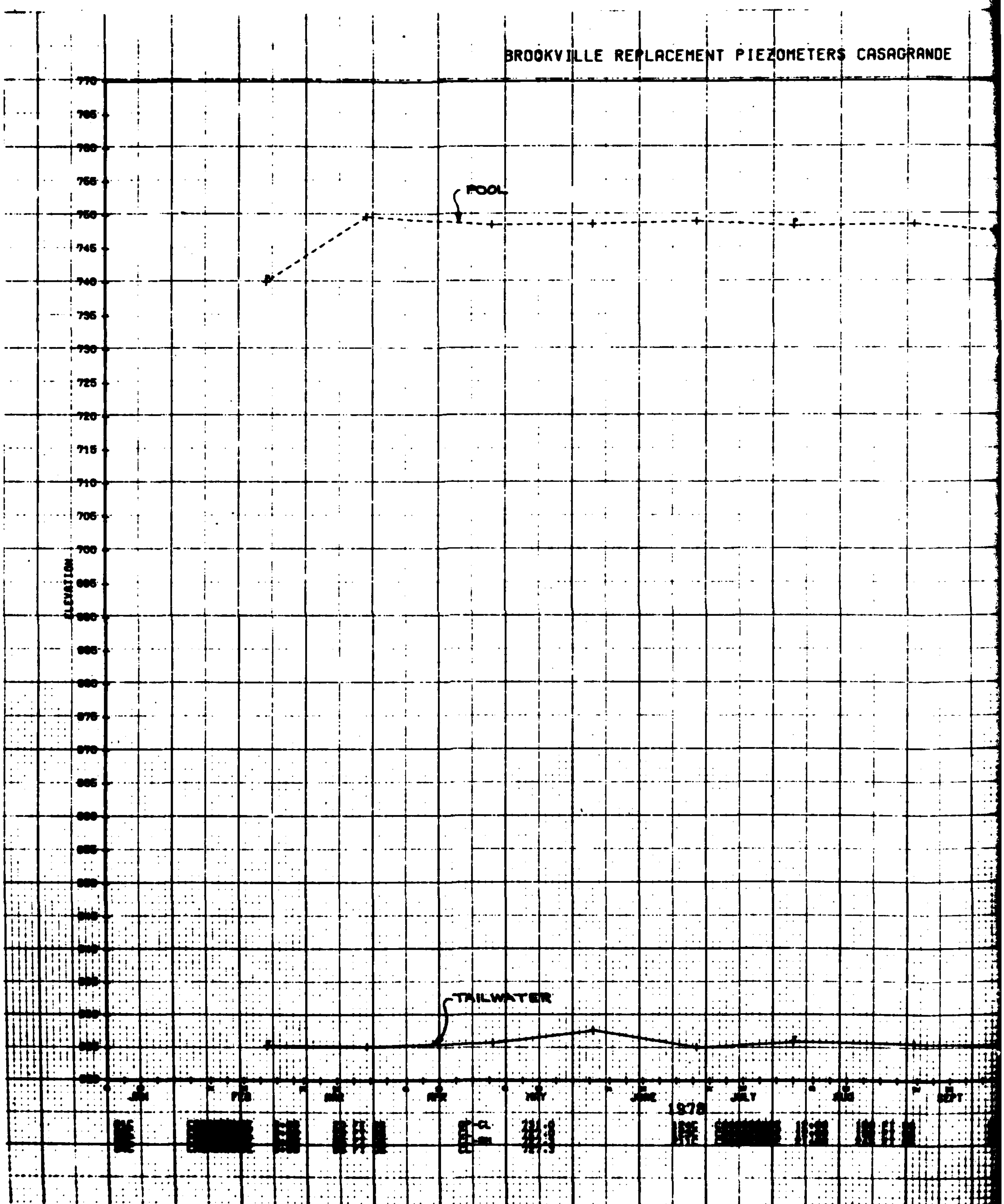
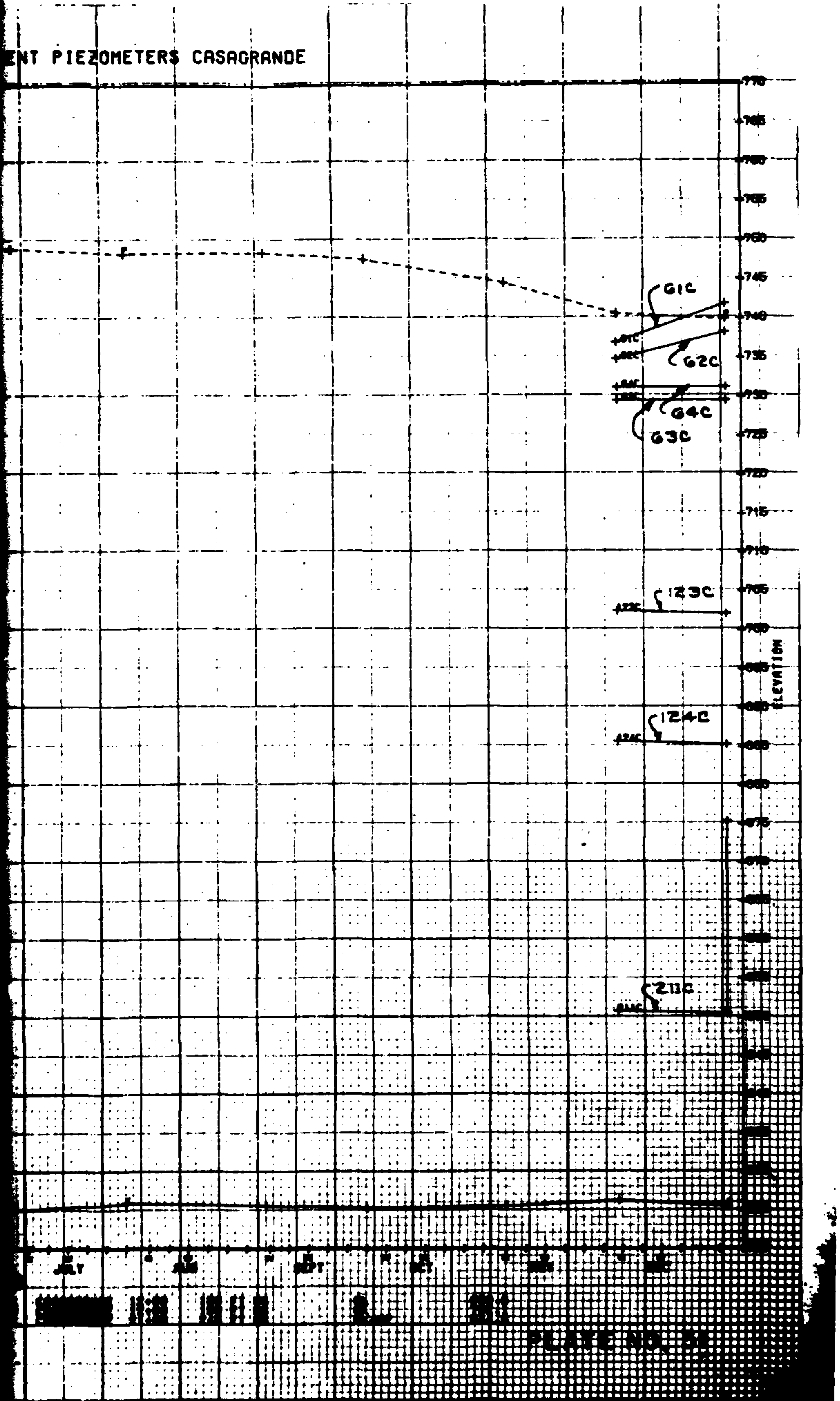
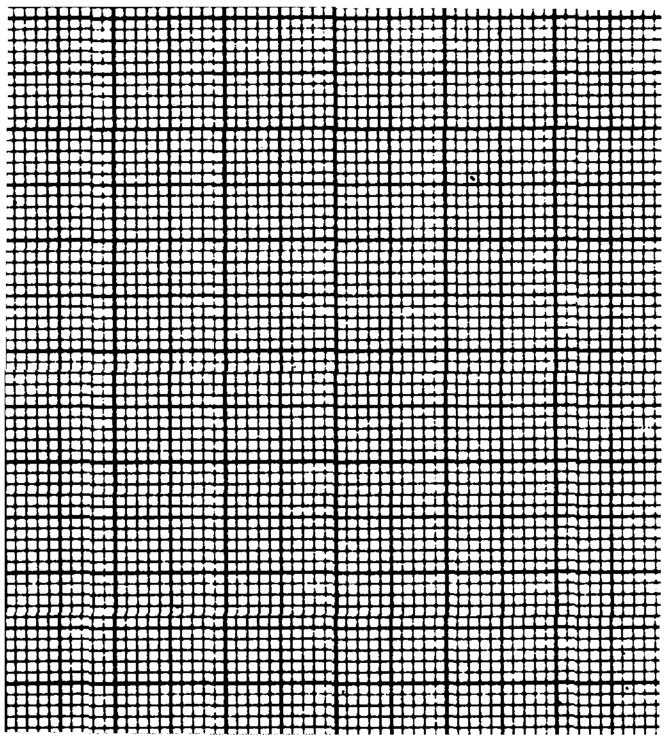


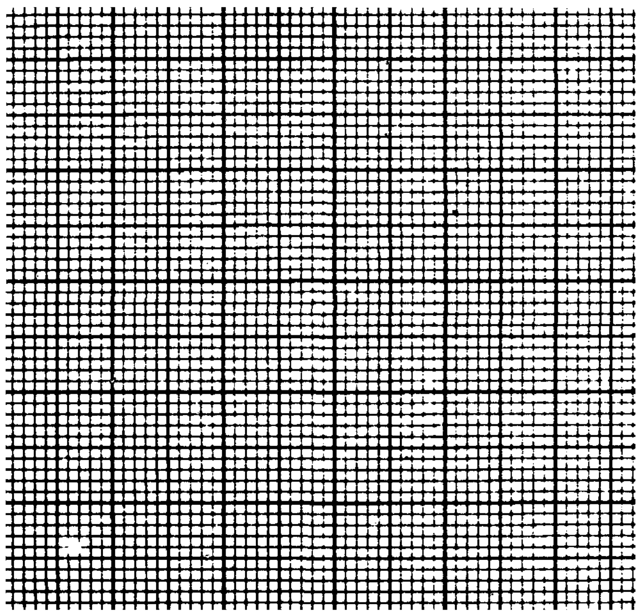
PLATE NO. 30

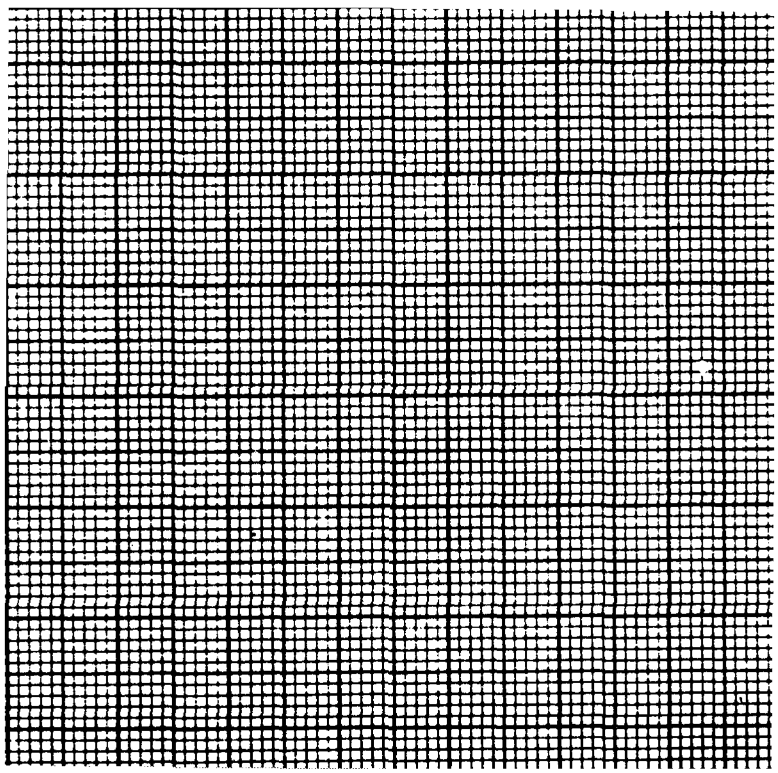
1 2

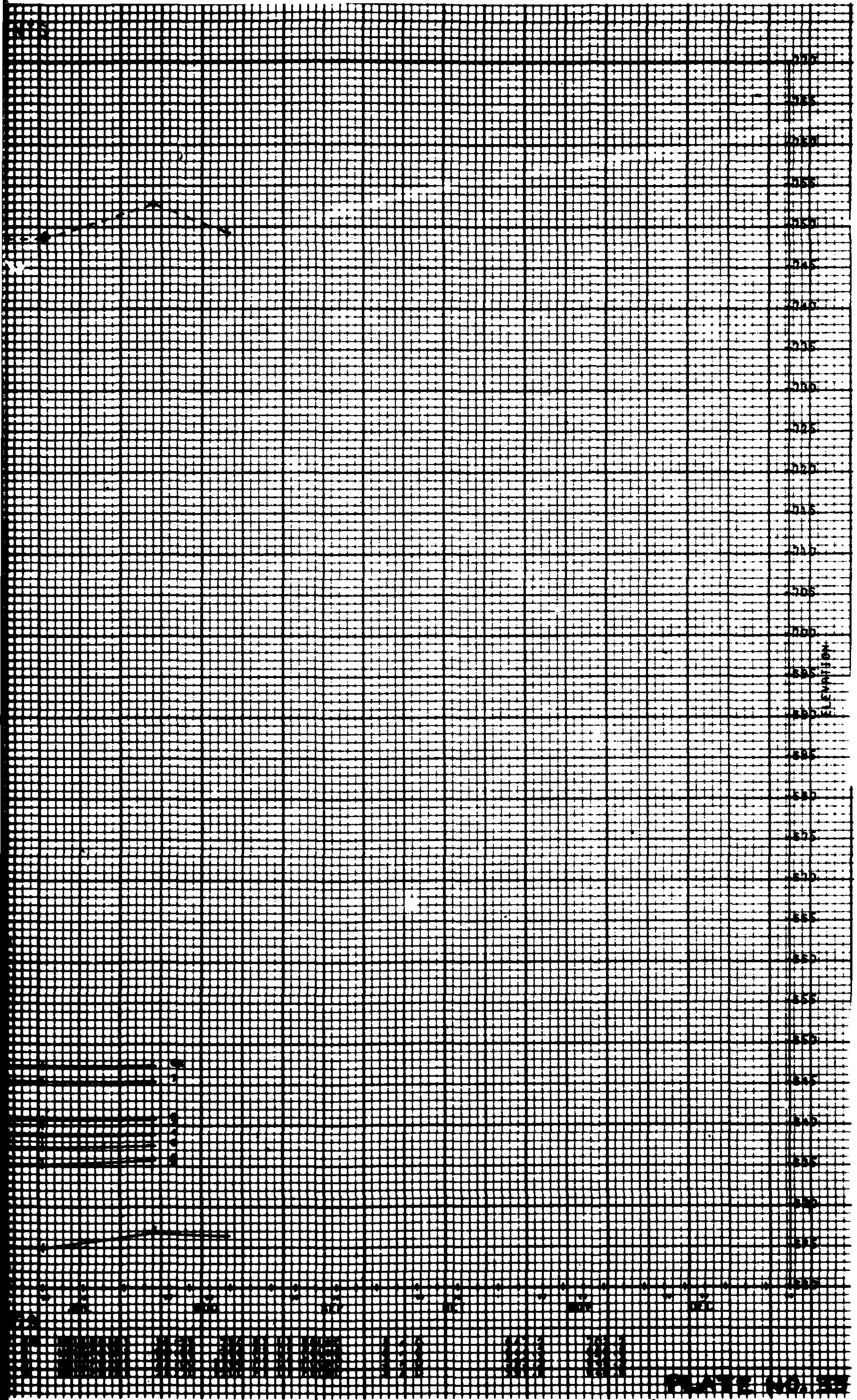

BROOKVILLE REPLACEMENT PIEZOMETERS CASAGRANDE
ELEVATION
POOL
TAILWATER
1978

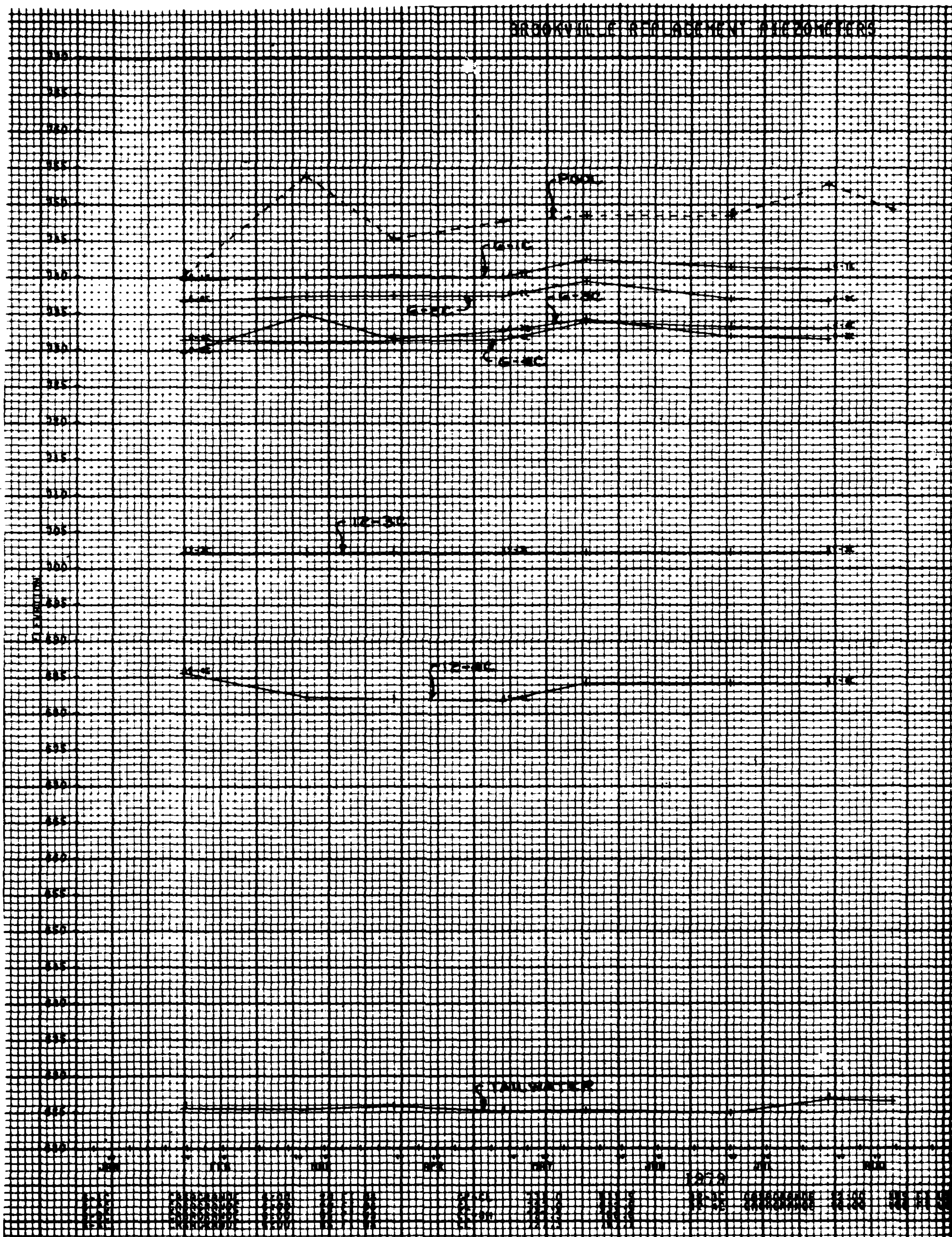

ENT PIEZOMETERS CASAGRANDE
G1C
G2C
G3C
G4C
123C
124C
211C
ELEVATION
JULY
SEPT

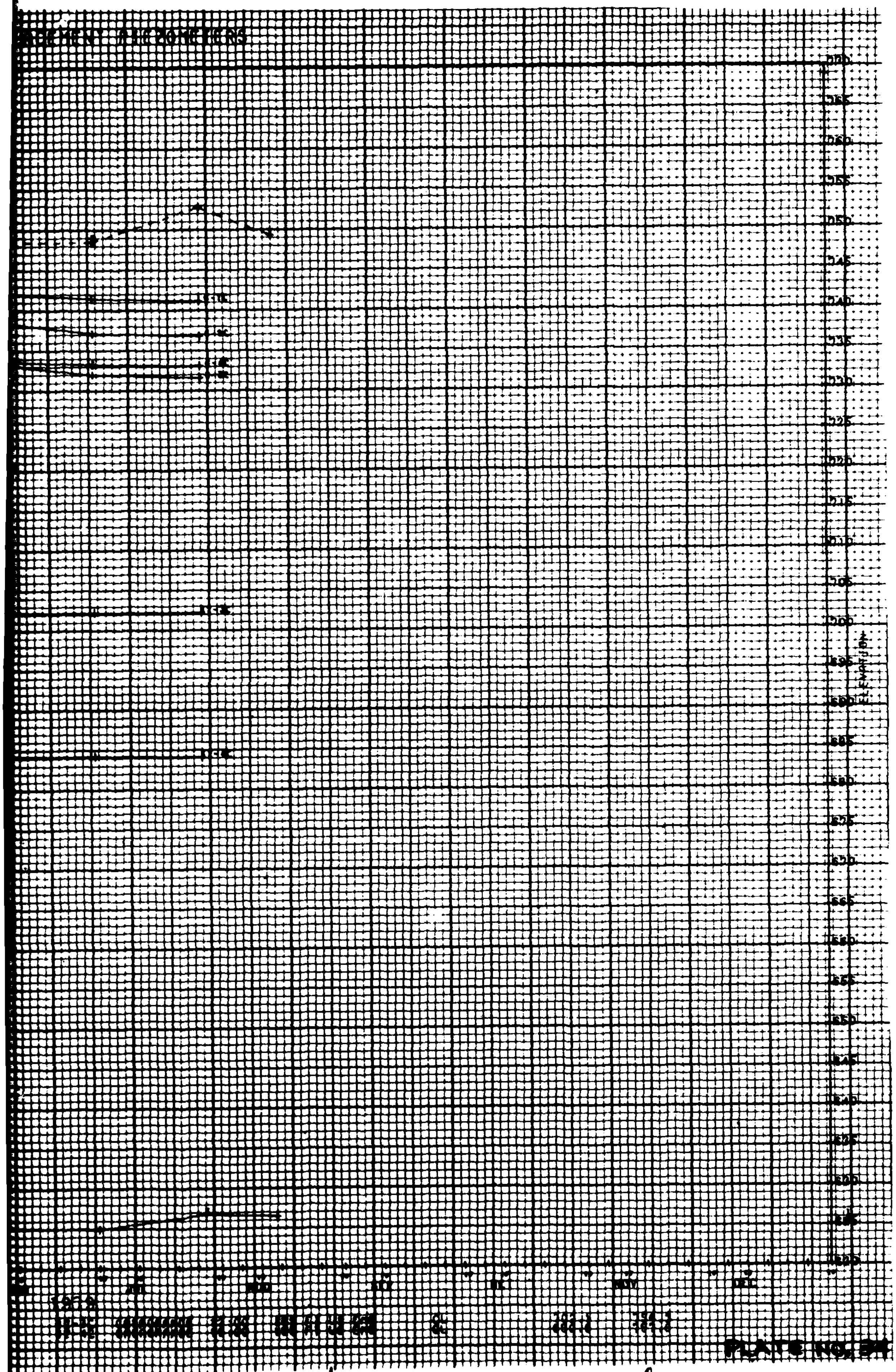







ELEVATION
PLATE NO.


BROOKVILLE REPLACEMENT PIEZOMETERS
POOL
TAILWATER
ELEVATION
1979


PIEZOMETERS
ELEVATION
PLATE NO.

CORPS OF ENGINEERS, U.S. ARMY OHIO RIVER DIVISION	COMPUTATION SHEET	PAGE OF PAGES DATE 1 FEB 79
INSTALLATION	SUBJECT BROOKVILLE LAKE, INDIANA	
COMPUTED BY JPJ CHECKED BY	COMPUTATION RELIEF WELL FLOWS	NUMBER

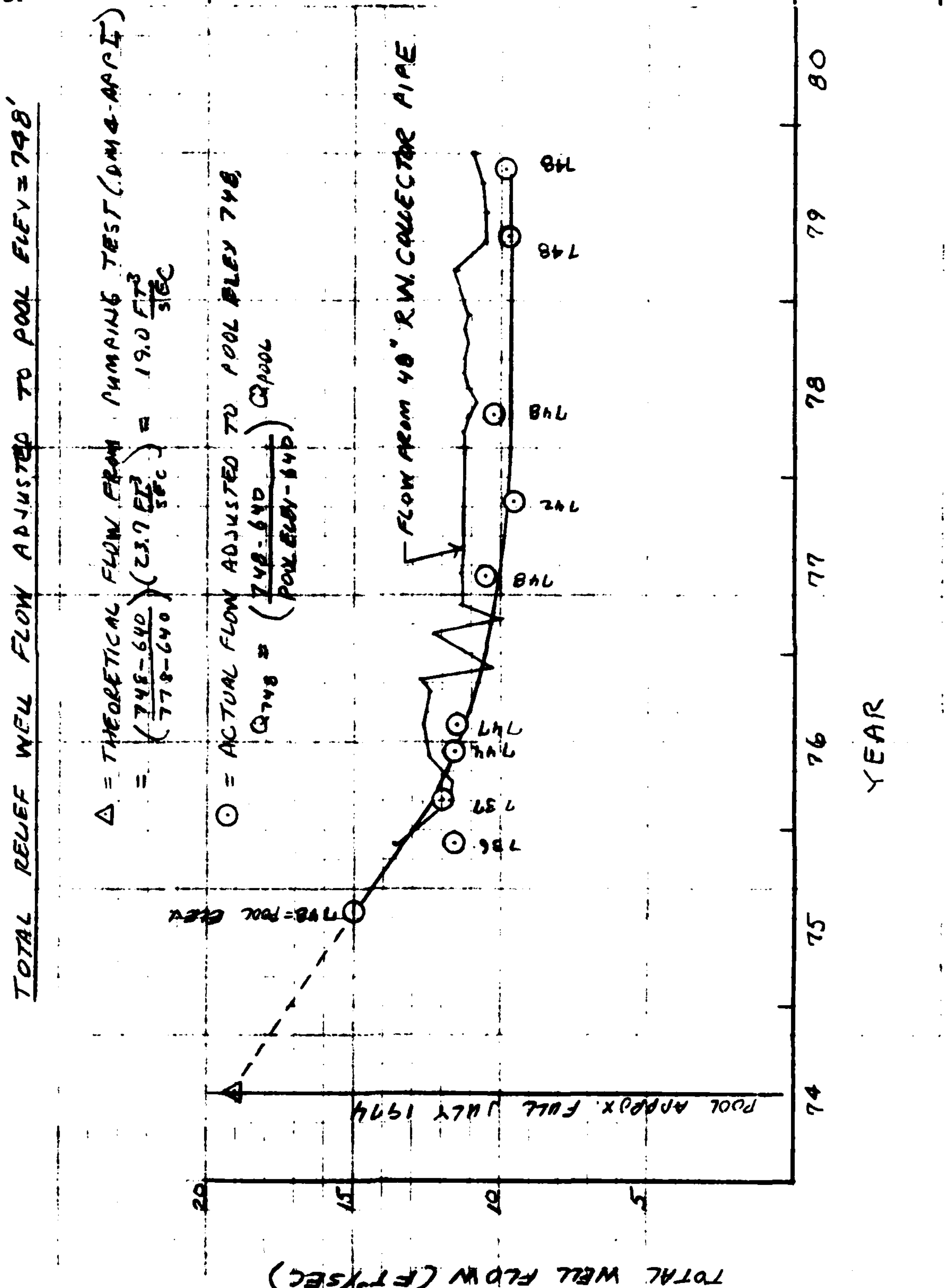


PLATE NO. 35

BROOKVILLE LAKE, INDIANA

RELIEF WELL SOUNDINGS

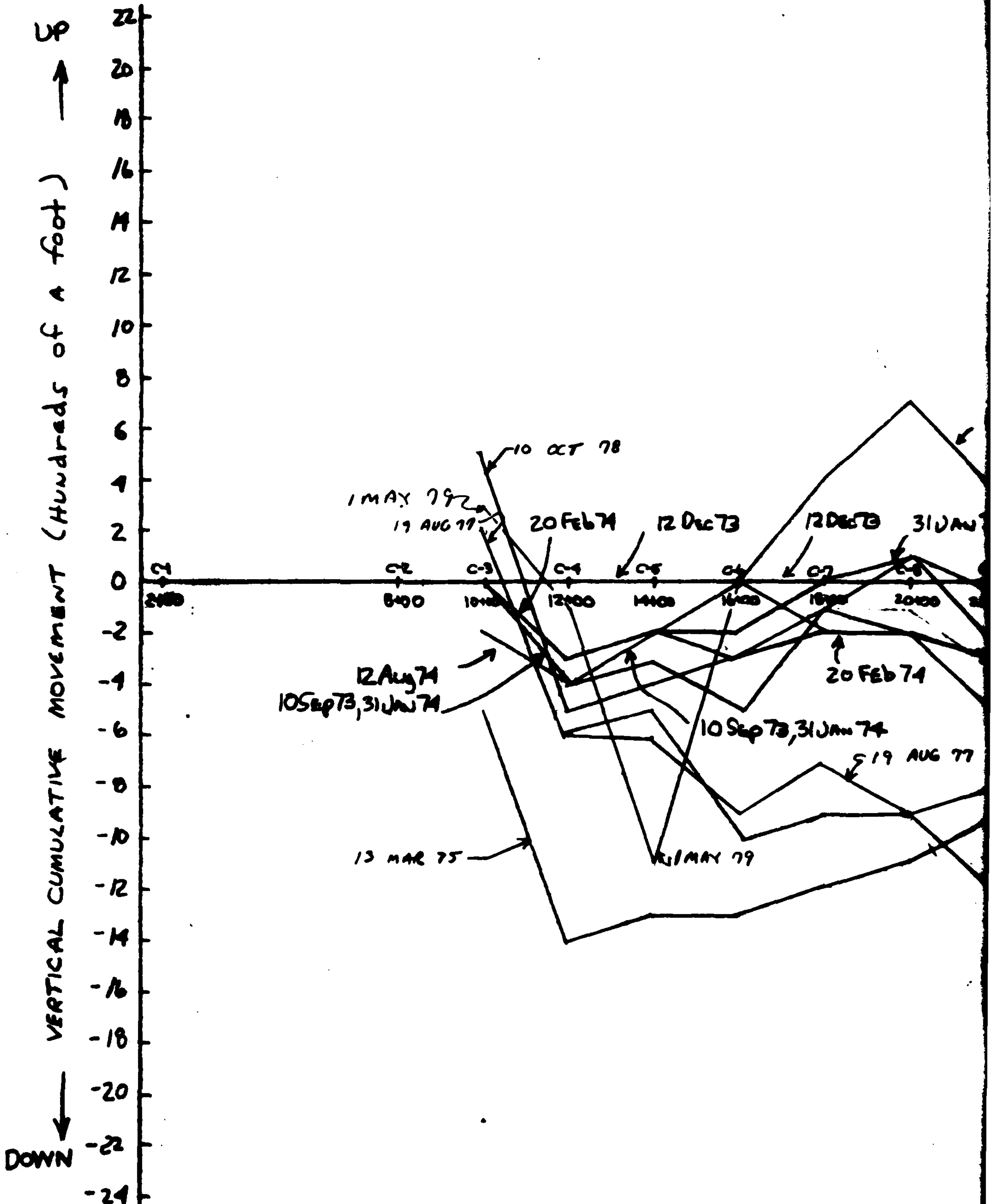
RELIEF WELL NO.	TOP RISER ELEVATION	BOTTOM ELEVATION	11 AUG 75 SOUNDED BOTTOM	11 AUG 75 SILTATION	29 APR 77 SOUNDED BOTTOM	29 APR 77 SILTATION
1	656.88	613.3	613.29	- .01	613.33	+ .03
1A	656.46	573.7	574.20	+ .50	574.21	+ .51
2	656.36	559.4	560.81	+ 1.41	560.83	+ 1.43
2A	656.13	550.5	550.31	- .19	550.34	- .16
3	656.06	535.5	536.17	+ .67	536.17	+ .67
3A	655.66	529.7	528.76	- .94	528.78	- .92
4	653.52	515.4	516.16	+ .76	516.13	+ .73
4A	655.17	518.0	518.26	+ .26	518.27	+ .27
5	655.01	513.8	514.73	+ .93	514.75	+ .95
5A	655.16	527.5	527.84	+ .34	527.88	+ .38
6	654.85	512.1	512.12	+ .02	512.15	+ .05
6A	654.54	533.0	532.92	- .08	532.93	- .07
7	654.49	515.3	514.96	- .34	514.98	- .32
7A	654.42	530.5	530.27	- .23	530.26	- .24
8	654.03	512.2	515.38	+ 3.18	515.44	+ 3.24
8A	654.17	521.4	521.84	- .06	521.82	- .08
9	653.83	522.5	522.16	- .34	522.24	- .26
9A	653.82	527.3	527.59	+ .29	527.38	+ .08
10	653.40	536.0	535.25	- .75	535.14	- .86
10A	652.62	524.5	524.68	+ .18	524.67	+ .17
11	651.95	531.7	533.80	+ 2.10	533.78	+ .08
12	651.87	538.9	539.64	+ .79	539.11	+ .21
13	651.24	542.1	543.33	+ 1.23	543.33	+ 1.23
14	650.38	549.9	550.02	+ .12	550.01	+ .11
15	647.96	553.8	554.75	+ .95	554.66	+ .86
16	648.00	557.2	559.31	+ 2.11	559.24	+ 2.04
17	647.85	570.0	569.53	- .47	569.52	- .48
18	646.97	584.1	583.98	- .12	584.01	- .09
19	647.05	593.7	593.65	- .05	593.66	- .04
20	646.98	607.4	607.67	+ .27	607.74	+ .34
21	646.77	619.5	620.74	+ 1.24	620.72	+ 1.22
22	646.52	619.6	619.92	+ .32	620.06	+ .46

INDIANA

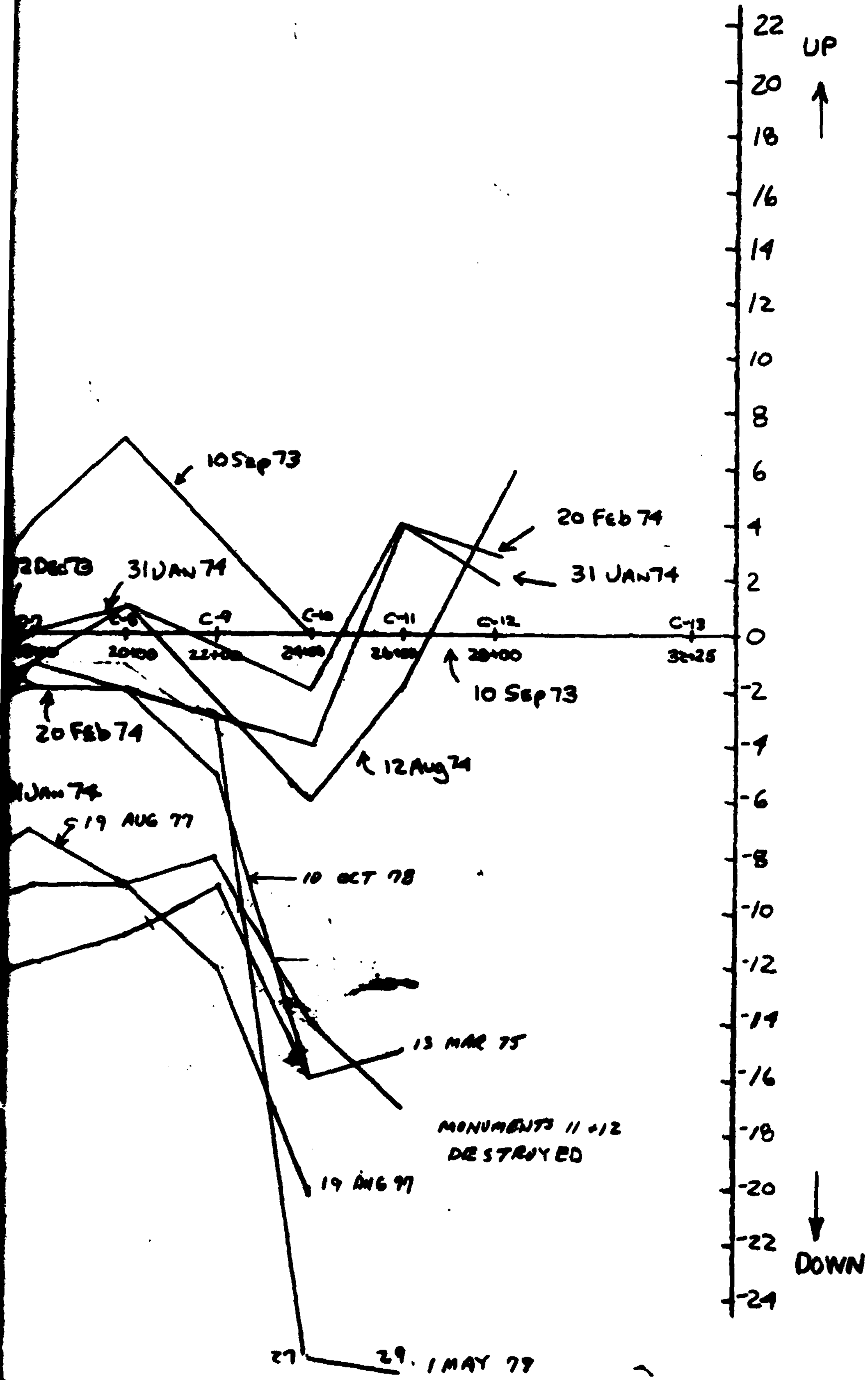
INGS

N	29 APR 77		24 APR 78		14 MAY 79		2 JUNE 80	
	SOUNDED BOTTOM	SILTATION	SOUNDED BOTTOM	SILTATION	SOUNDED BOTTOM	SILTATION	SOUNDED BOTTOM	SILTATION
	613.33	+ .03	613.19	- .11	613.21	-0.09	613.18	-0.12
	574.21	+ .51	574.12	+ .42	574.13	+0.43	574.11	+0.41
	560.83	+1.43	560.82	+1.42	560.83	+1.43	560.81	+1.41
	550.34	- .16	550.33	- .17	550.68	+0.18	550.33	-0.17
	536.17	+ .67	536.17	+ .67	536.33	+0.83	536.21	+0.71
	528.78	- .92	528.78	- .92	528.88	-0.82	528.81	-0.89
	516.13	+ .73	516.12	+ .72	516.30	+0.90	516.12	+0.72
	518.27	+ .27	518.25	+ .25	518.42	+0.42	518.27	+0.27
	514.75	+ .95	514.75	+ .95	515.01	+1.21	514.76	+0.96
	527.88	+ .38	527.86	+ .38	528.16	+0.66	527.86	+0.36
	512.15	+ .05	512.13	+ .03	512.51	+0.41	512.20	+0.10
	532.93	- .07	532.92	- .06	533.31	+0.31	532.94	-0.06
	514.98	- .32	514.98	- .32	515.26	-0.04	514.99	-0.31
	530.26	- .24	530.26	-.24	530.26	-0.24	530.27	-0.23
	515.44	+3.24	515.35	+3.15	515.35	+3.15	515.78	+3.58
	521.82	-.08	521.82	-.08	522.17	+0.27	521.82	-0.08
	522.24	-.26	522.24	-.26	522.38	-0.12	522.23	-0.27
	527.38	+.08	524.38	+.08	527.49	+0.19	527.42	+0.12
	535.14	-.86	535.24	-.76	535.24	-0.76	535.25	-0.75
	524.67	+.17	524.66	+.16	524.82	+0.32	524.72	+0.22
	533.78	+.08	533.77	+2.07	533.87	+2.17	533.80	+2.10
	539.11	+.21	539.64	+.74	539.63	+0.73	539.67	+0.77
	543.33	+1.23	543.41	+1.31	543.40	+1.3	543.44	+1.34
	550.01	+.11	549.97	+.07	549.98	+0.08	549.98	+0.08
	554.66	+.86	554.65	+.85	554.67	+0.87	554.66	+0.86
	559.24	+2.04	559.19	+1.99	559.31	+2.11	559.30	+2.10
	569.52	-.48	569.54	-.46	569.57	-0.43	569.55	-0.45
	584.01	-.09	584.04	-.06	584.15	+0.05	584.02	-0.08
	593.66	-.04	593.82	+.12	593.79	+0.09	593.80	+0.10
	607.74	+.34	607.69	+.29	607.81	+0.41	607.68	+0.28
	620.72	+1.22	620.72	+1.22	621.09	+1.59	620.72	+1.22
	620.06	+.46	619.91	+.31	620.12	+0.22	619.87	+0.27

PLATE 36



UP
DOWN
VERTICAL CUMULATIVE MOVEMENT (Hundreds of a foot)
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
10 OCT 78
1 MAY 79
19 AUG 77
20 Feb 74
12 Dec 73
12 Dec 73
31 JAN
12 Aug 74
10 Sep 73, 31 Jan 74
20 FEB 74
10 Sep 73, 31 Jan 74
19 AUG 77
1 MAY 79
13 MAR 75

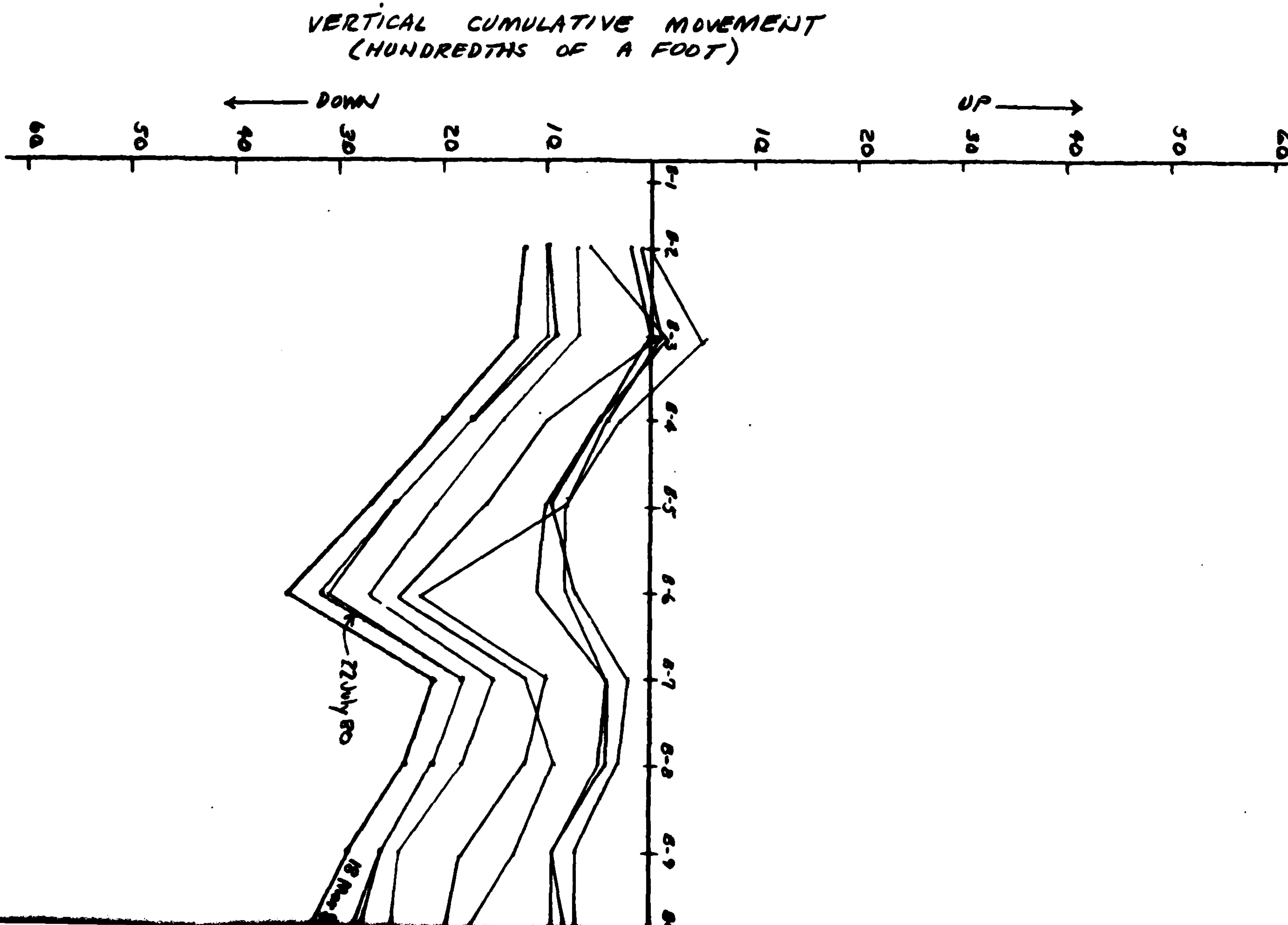


27 July 73	
INITIAL READING	
MON. NO.	ELEV.
C-3	678.12
C-4	679.36
C-5	678.50
C-6	678.34
C-7	678.65
C-8	678.90
C-9	694.86
C-10	700.01
C-11	686.50
C-12	680.13
C-13	808.86

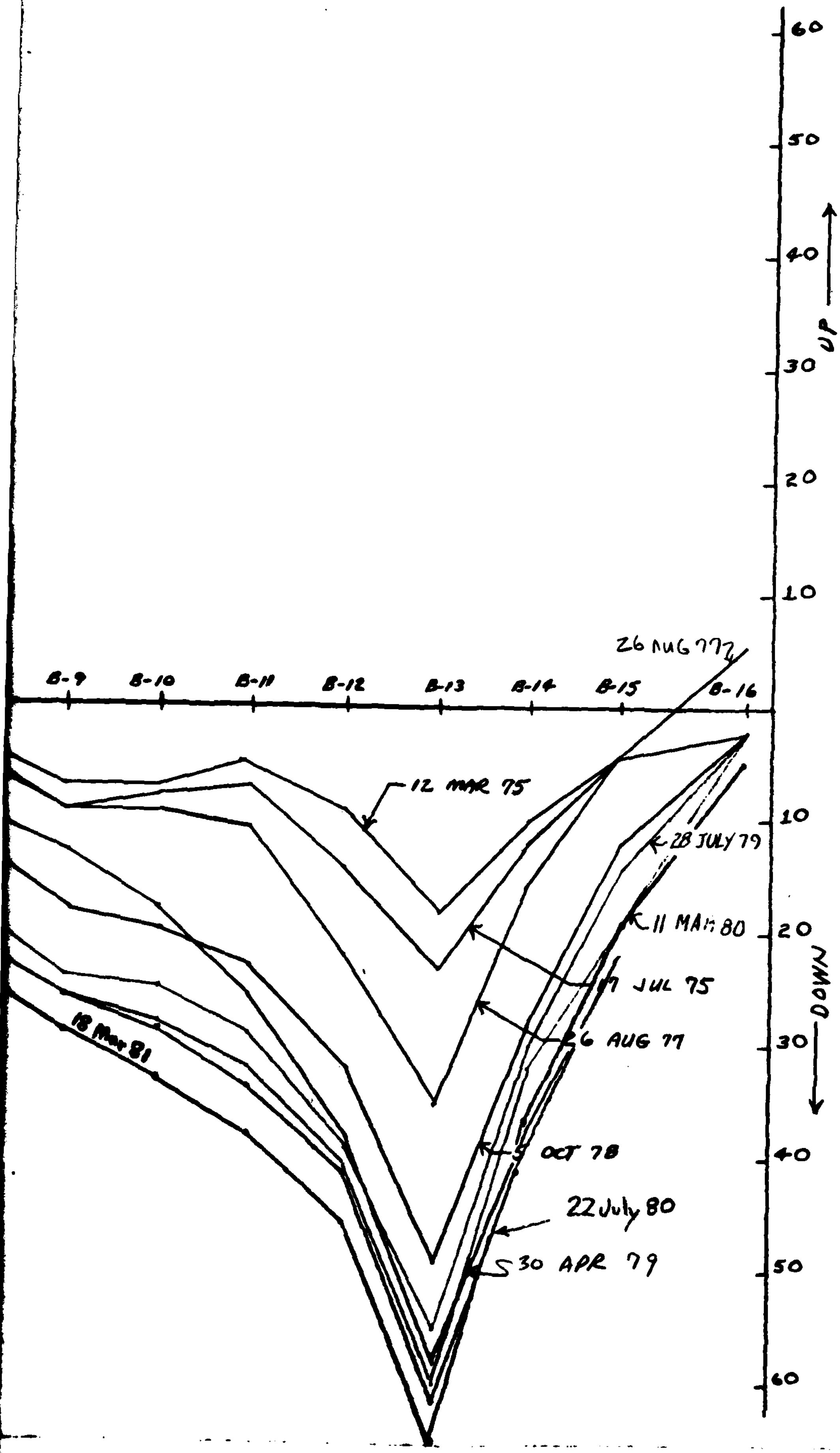
BROOKVILLE LAKE
MOVEMENT MONUMENTS
400' DOWNSTREAM ℄
VERTICAL MOVEMENT

PLATE 37

1 2



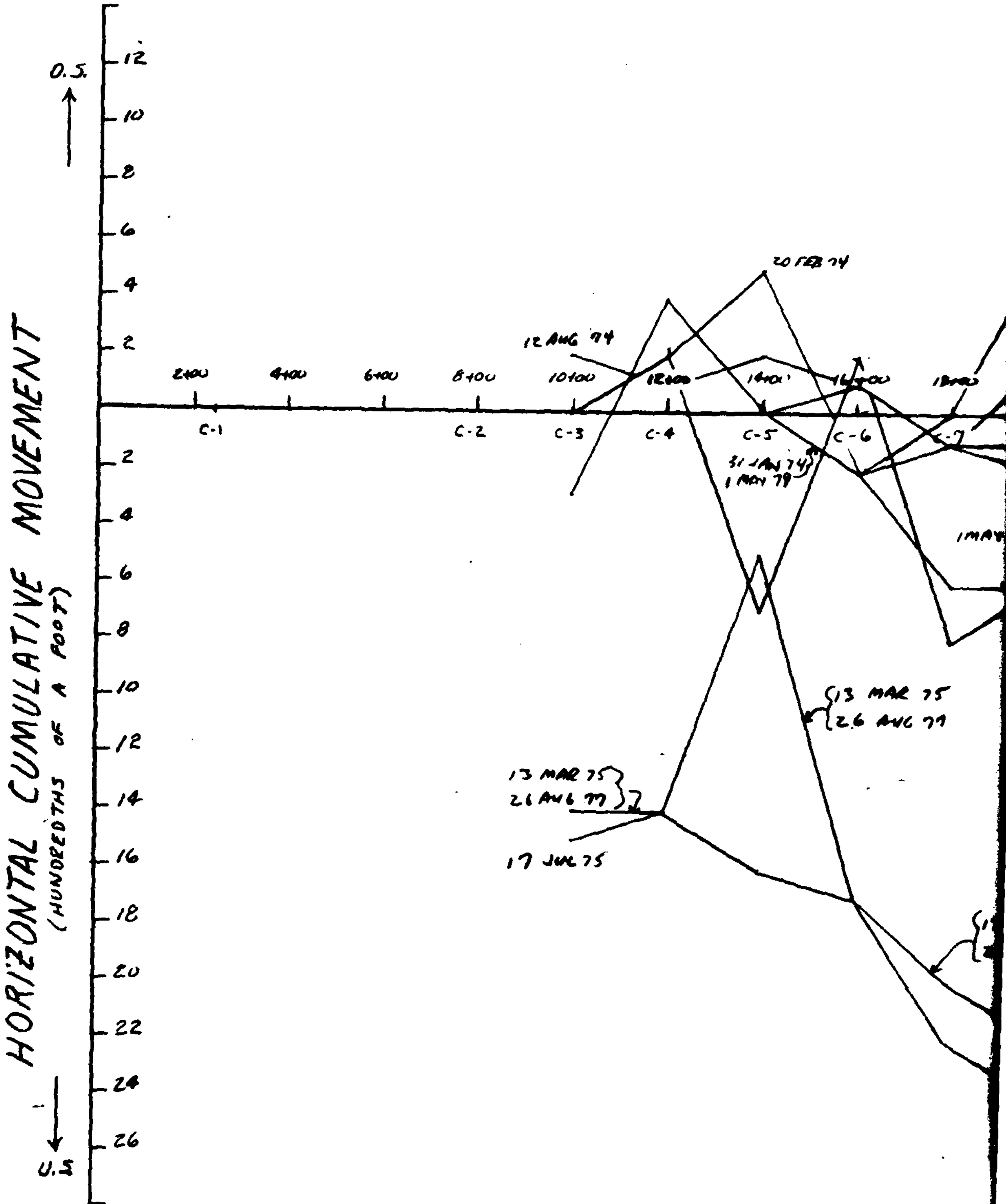
VERTICAL CUMULATIVE MOVEMENT
(HUNDREDTHS OF A FOOT)
DOWN
UP
60
50
40
30
20
10
10
20
30
40
50
60
B-1
B-2
B-3
B-4
B-5
B-6
B-7
B-8
B-9
22 July 80

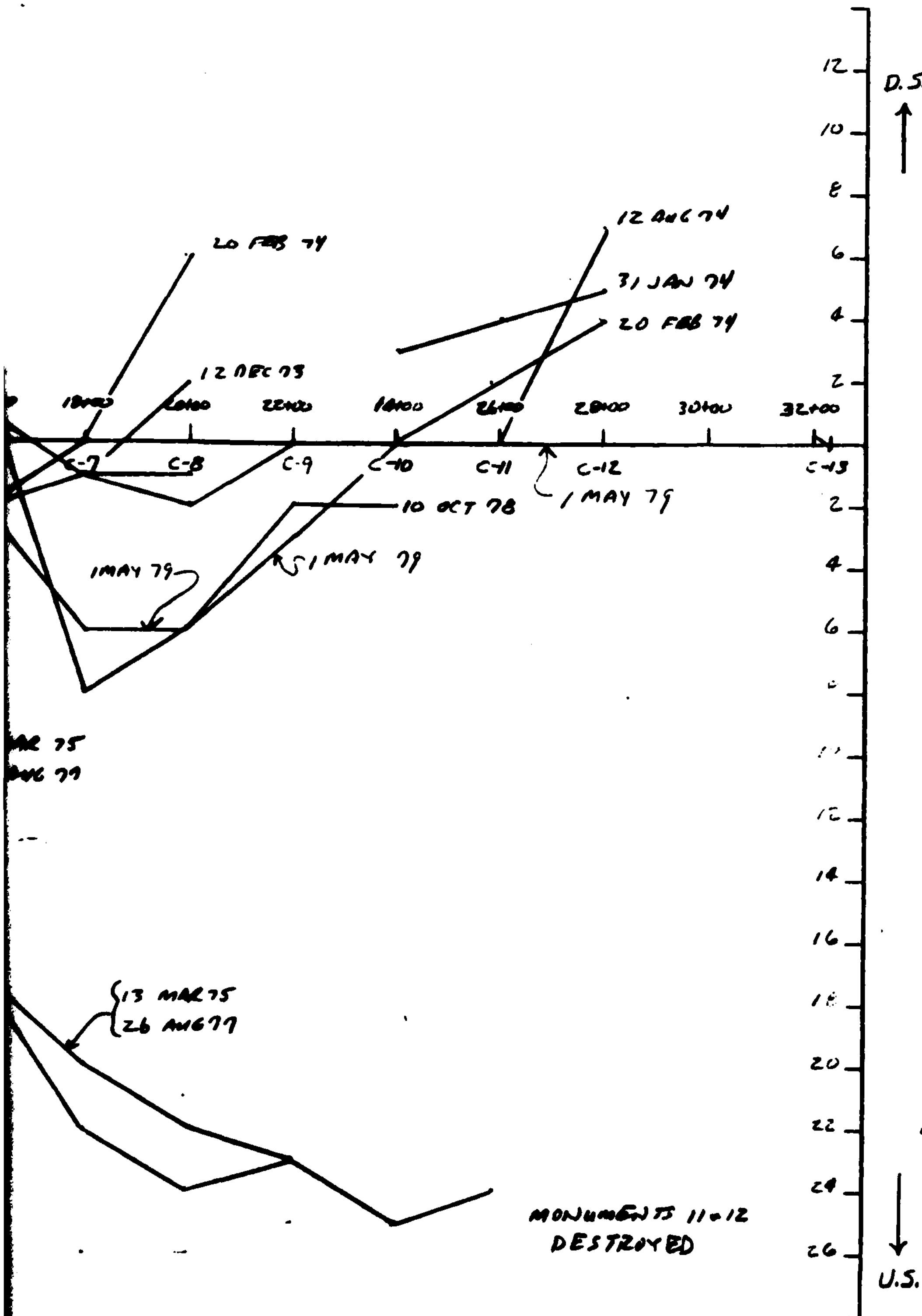


INITIAL READING 21 AUG 74	
MON	ELEV.
B-2	808.80
B-3	808.79
B-4	809.26
B-5	809.78
B-6	809.67
B-7	809.63
B-8	809.87
B-9	809.73
B-10	809.92
B-11	809.82
B-12	809.49
B-13	809.80
B-14	809.60
B-15	808.56
B-16	810.71

BROOKVILLE LAKE
MOVEMENT MONUMENTS
B LINE 15' DS
VERTICAL MOVEMENT

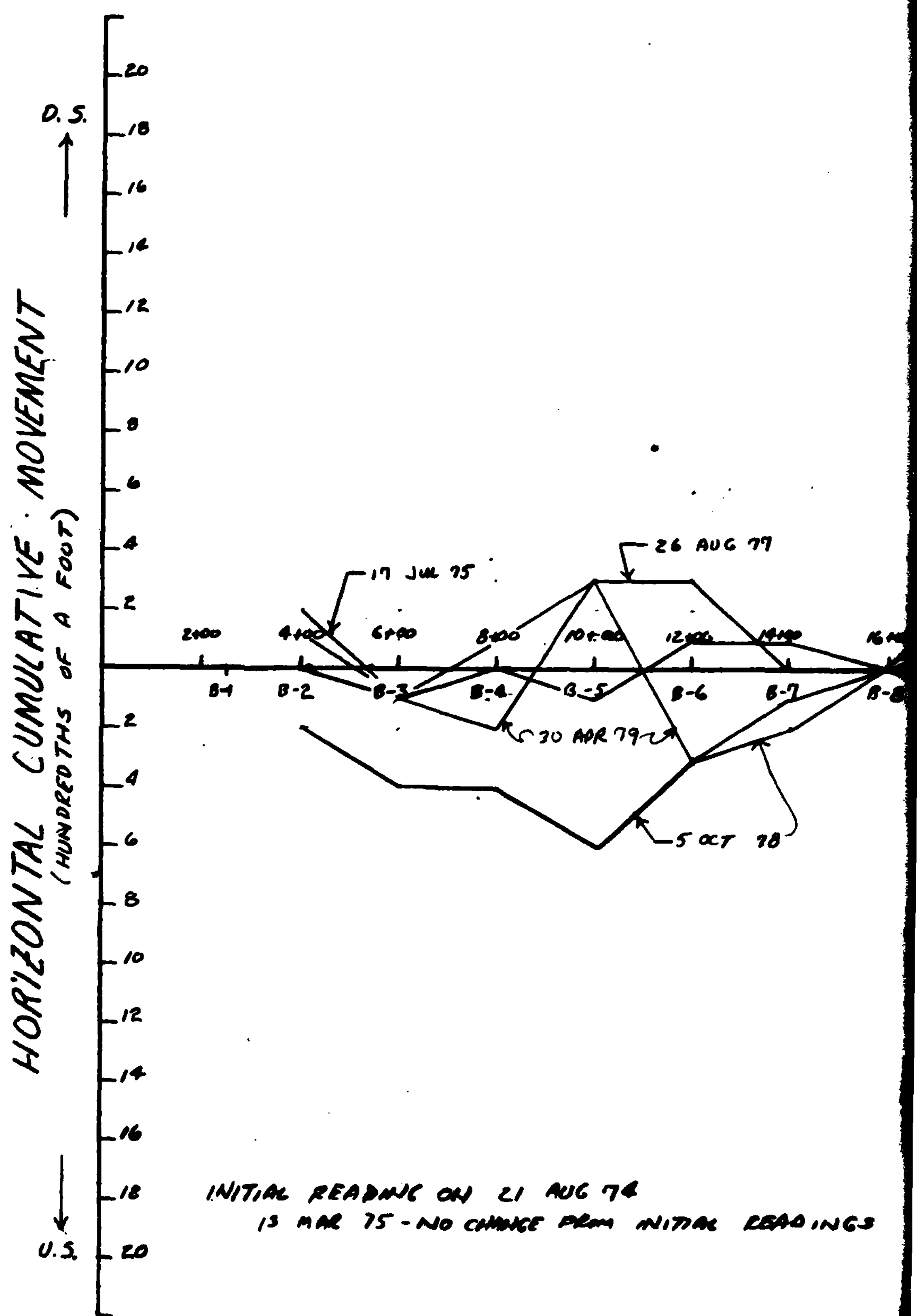
PLATE 38


HORIZONTAL CUMULATIVE MOVEMENT
(HUNDREDTHS OF A FOOT)
O.S.
U.S
12
10
8
6
4
2
2
4
6
8
10
12
14
16
18
20
22
24
26
2400
4400
6400
8400
10400
12400
14400
16400
C-1
C-2
C-3
C-4
C-5
C-6
C-7
20 FEB 74
12 AUG 74
31 JAN 74
1 MAY 79
13 MAR 75
26 AUG 77
13 MAR 75
26 AUG 77
17 JUL 75

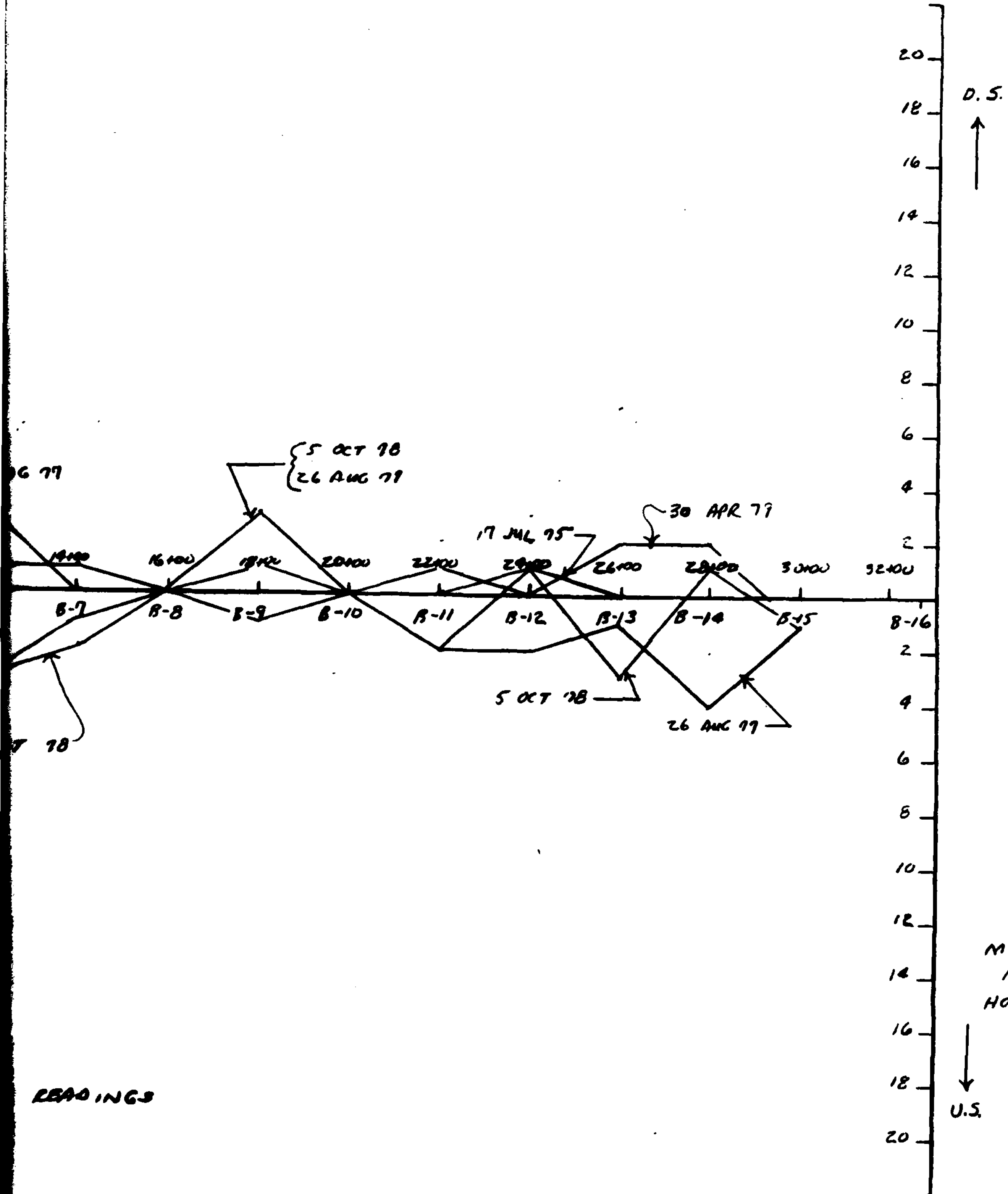


BROOKVILLE LAKE
MOVEMENT MONUMENTS
400' DOWNSTREAM &
HORIZONTAL MOVEMENT

PLATE 39



HORIZONTAL CUMULATIVE MOVEMENT
(HUNDREDTHS OF A FOOT)
D.S.
U.S.
20
18
16
14
12
10
8
6
4
2
2+00
4+00
6+00
8+00
10+00
12+00
14+00
B-1
B-2
B-3
B-4
B-5
B-6
B-7
17 JUL 75
26 AUG 77
30 APR 79
5 OCT 78
INITIAL READING ON 21 AUG 74
13 MAR 75 - NO CHANGE FROM INITIAL READINGS



BROOKVILLE LA
MOVEMENT MONUM
15' DOWNSTREAM
HORIZONTAL MOVEM

PLATE 40

1 2

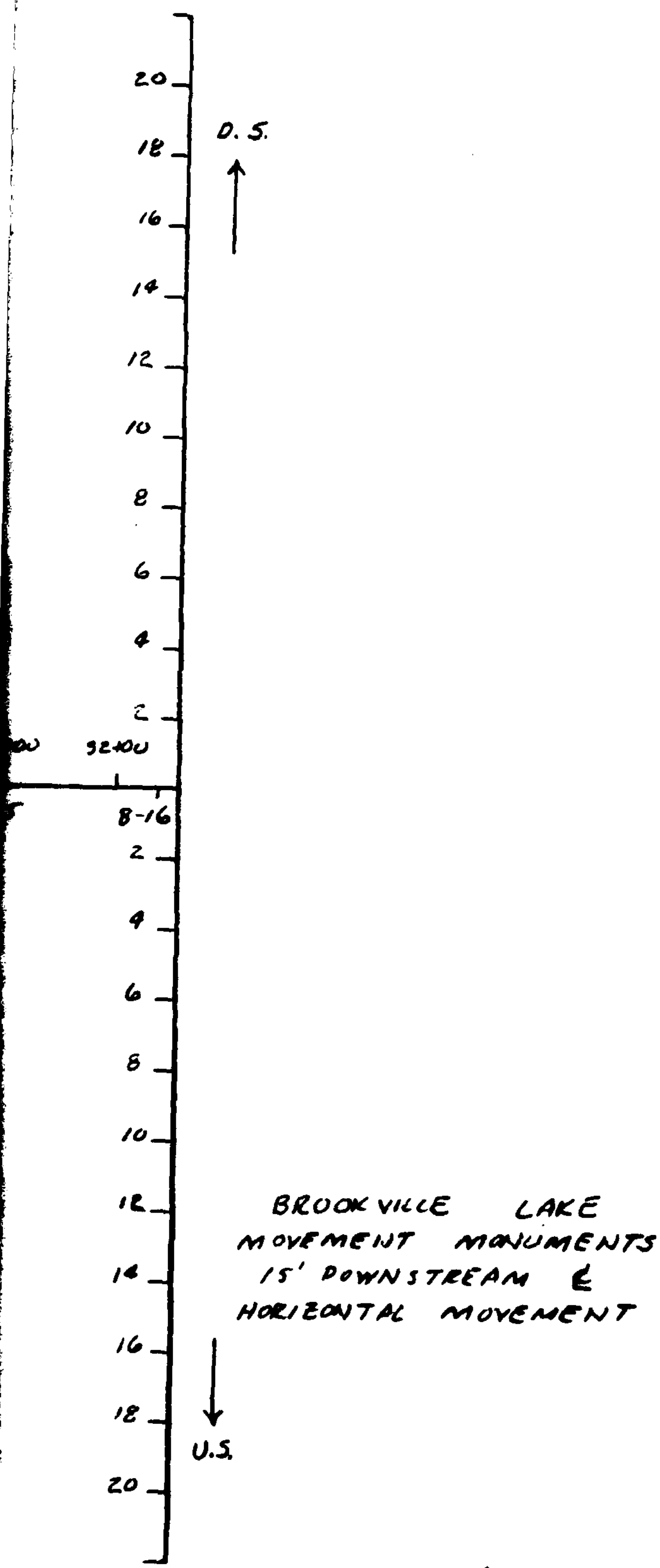
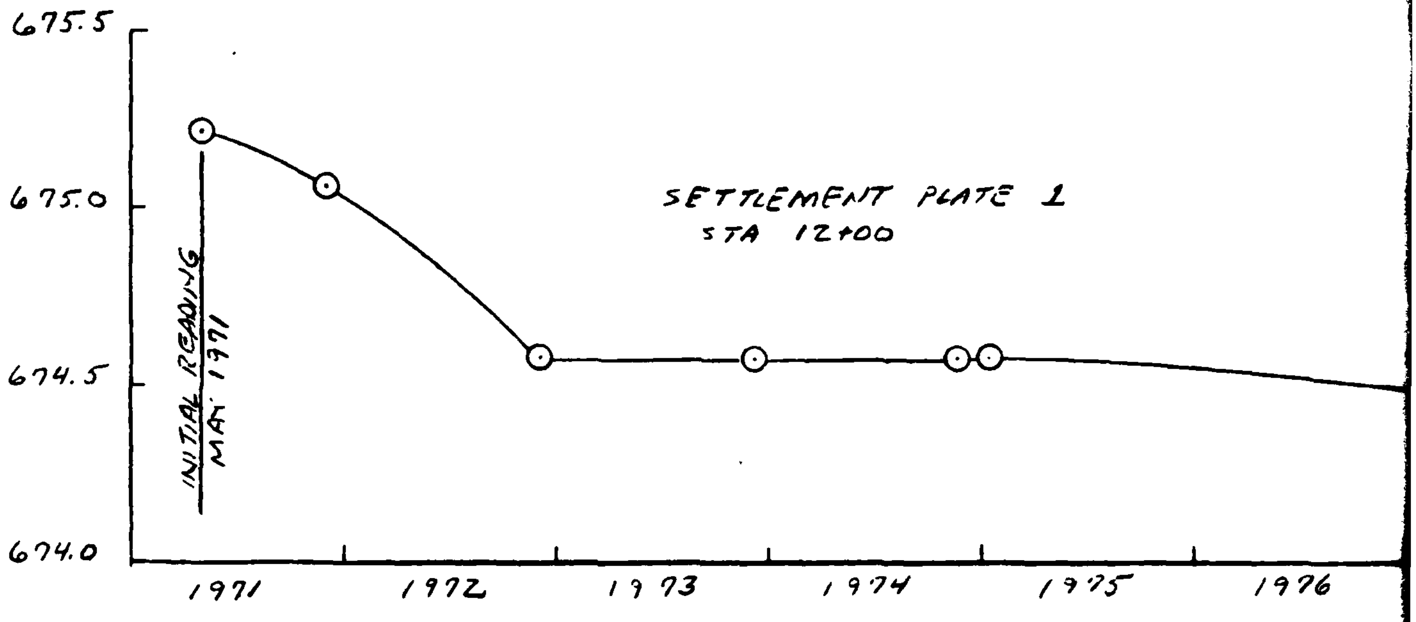
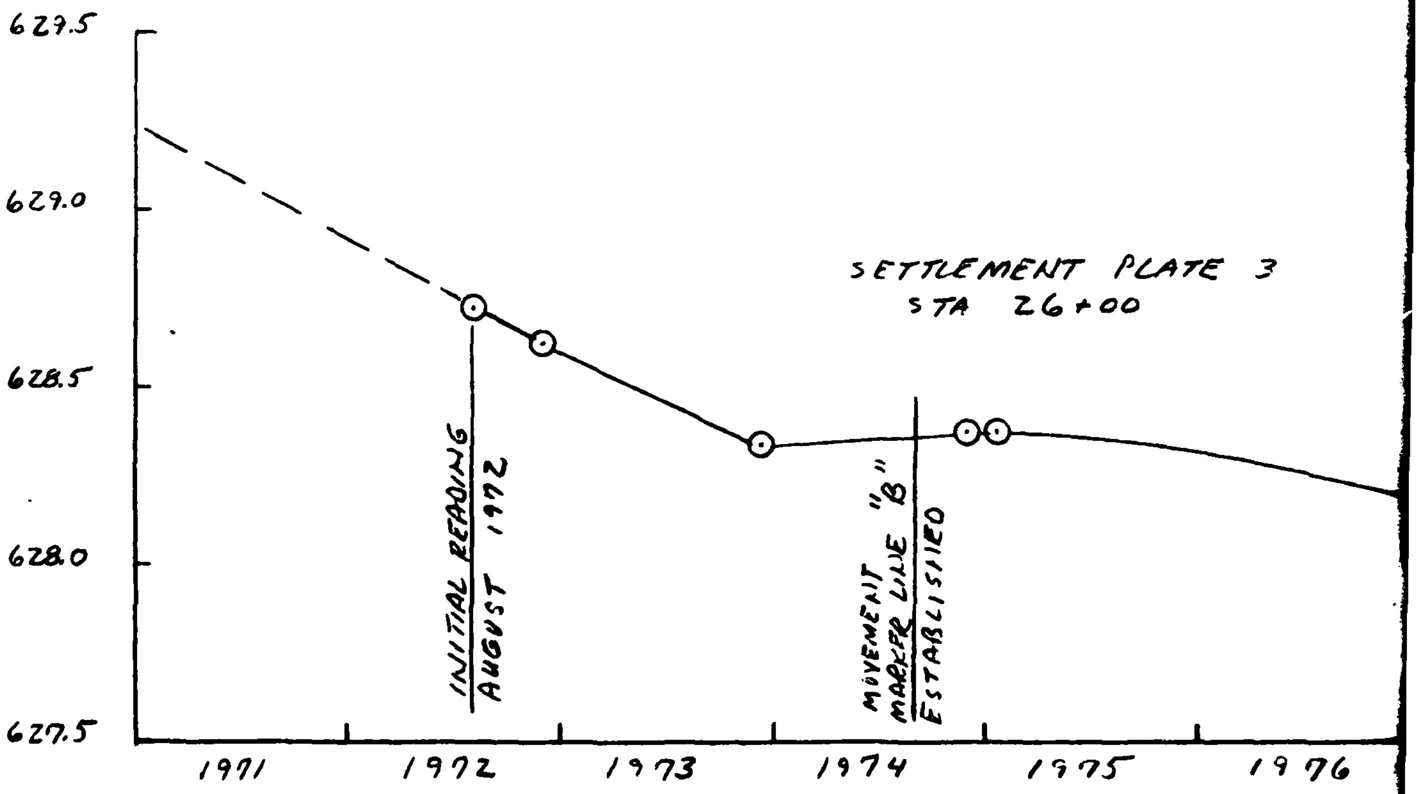

20
18
16
14
12
10
8
6
4
2
D. S.
32+00
8-16
2
4
6
8
10
12
14
16
18
20
U.S.
BROOKVILLE LAKE
MOVEMENT MONUMENTS
15' DOWNSTREAM ℄
HORIZONTAL MOVEMENT

PLATE 40

BROOKVILLE LAKE, IN

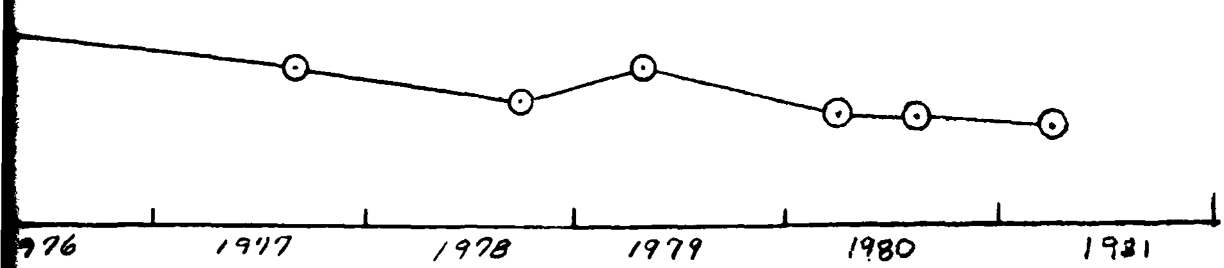
SETTLEMENT PLATES





INDIANA

ES



BROOKVILLE LAKE
SETTLEMENT PLATES

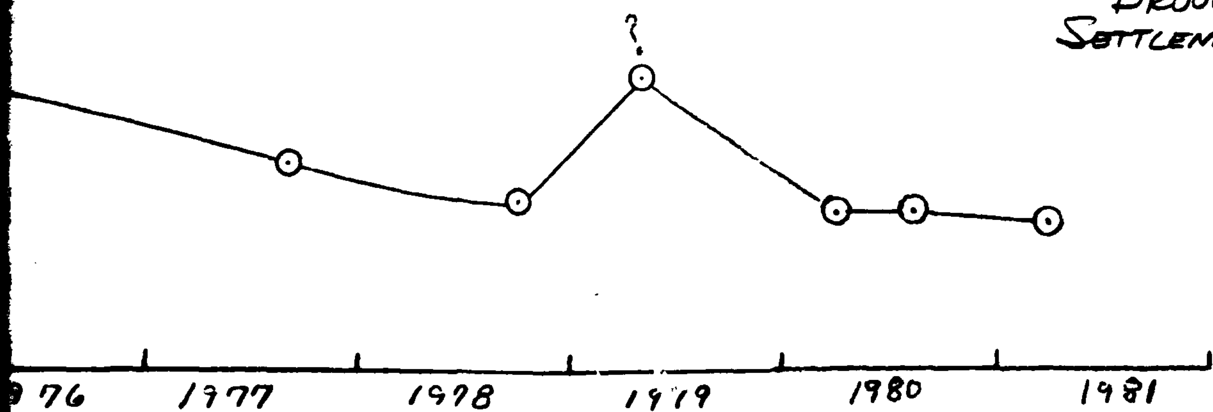
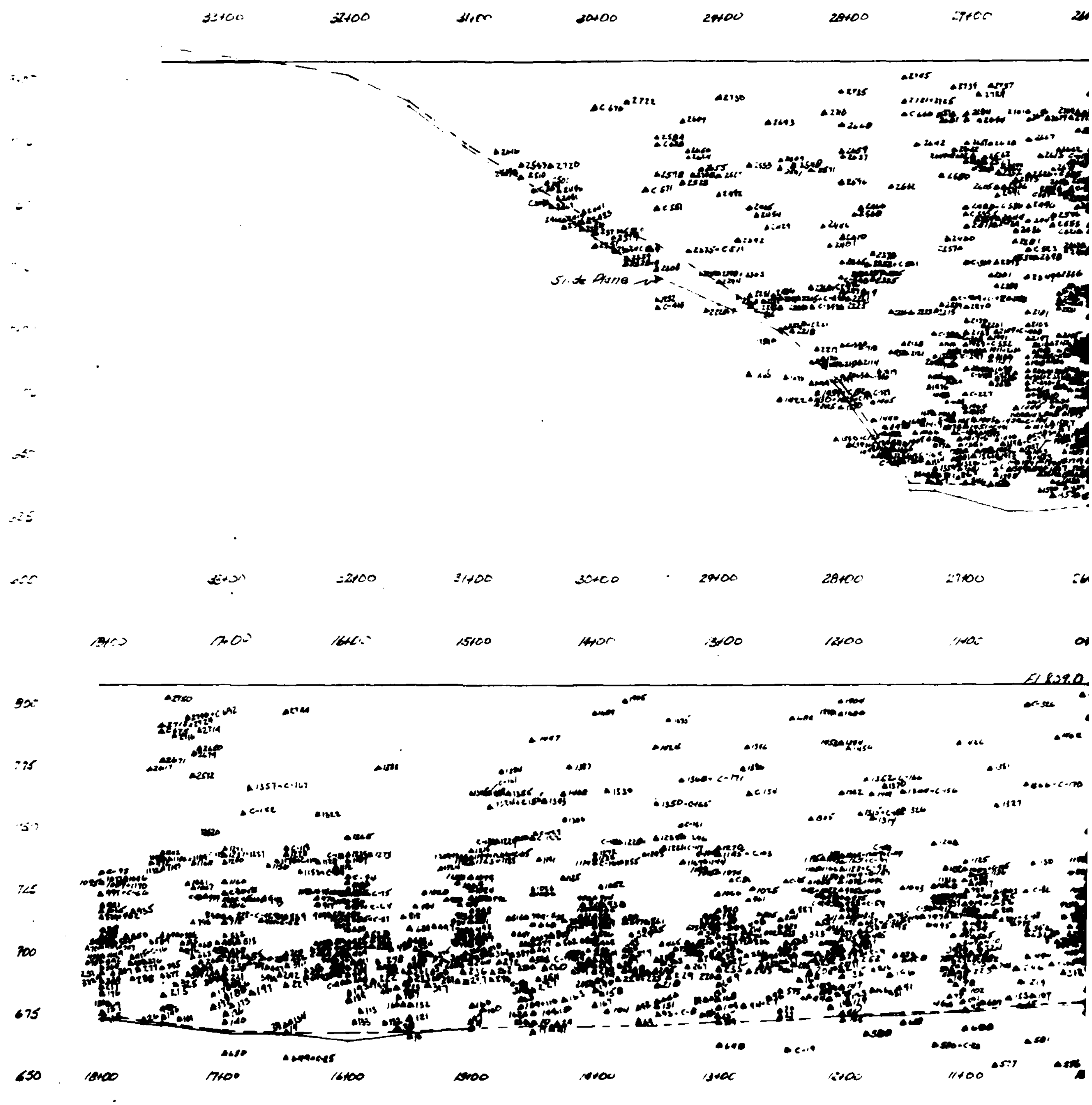
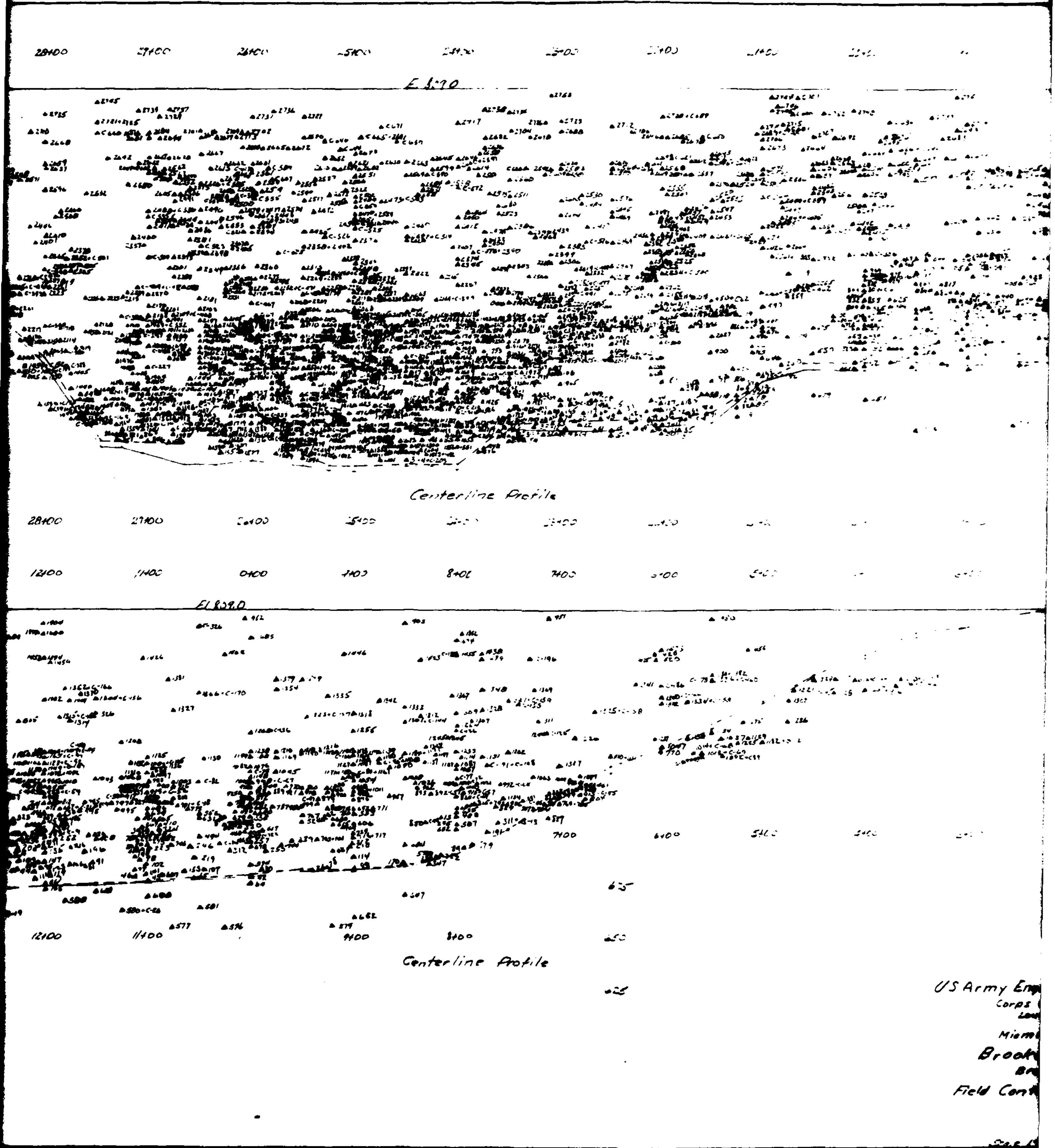


PLATE 41

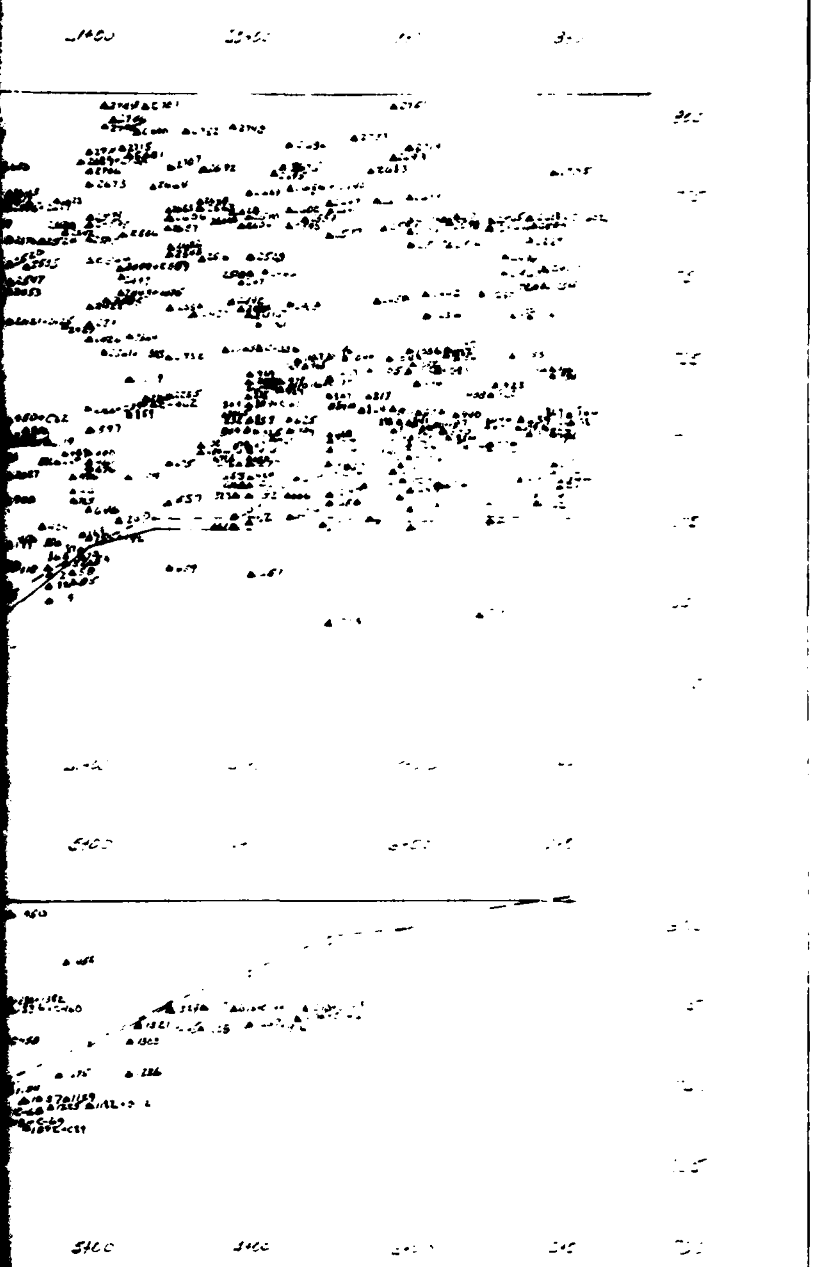
2

1 3


32400
31400
30400
29400
28400
Slide Plane
29400
28400
17400
16400
15400
14400
13400
12400
El 839.0
950
775
725
700
675
650
18400
17400
16400
15400
14400
13400
12400
11400


28400
27400
Centerline Profile
12400
11400
8400
7400
6400
El 839.0
Centerline Profile
US Army Eng
Corps
Field Cont

US Army



US Army Engineer District, Louisville
Corps of Engineers
Louisville Ky.

Miami River Basin

Brookville Lake Dam

Brookville, Ind.

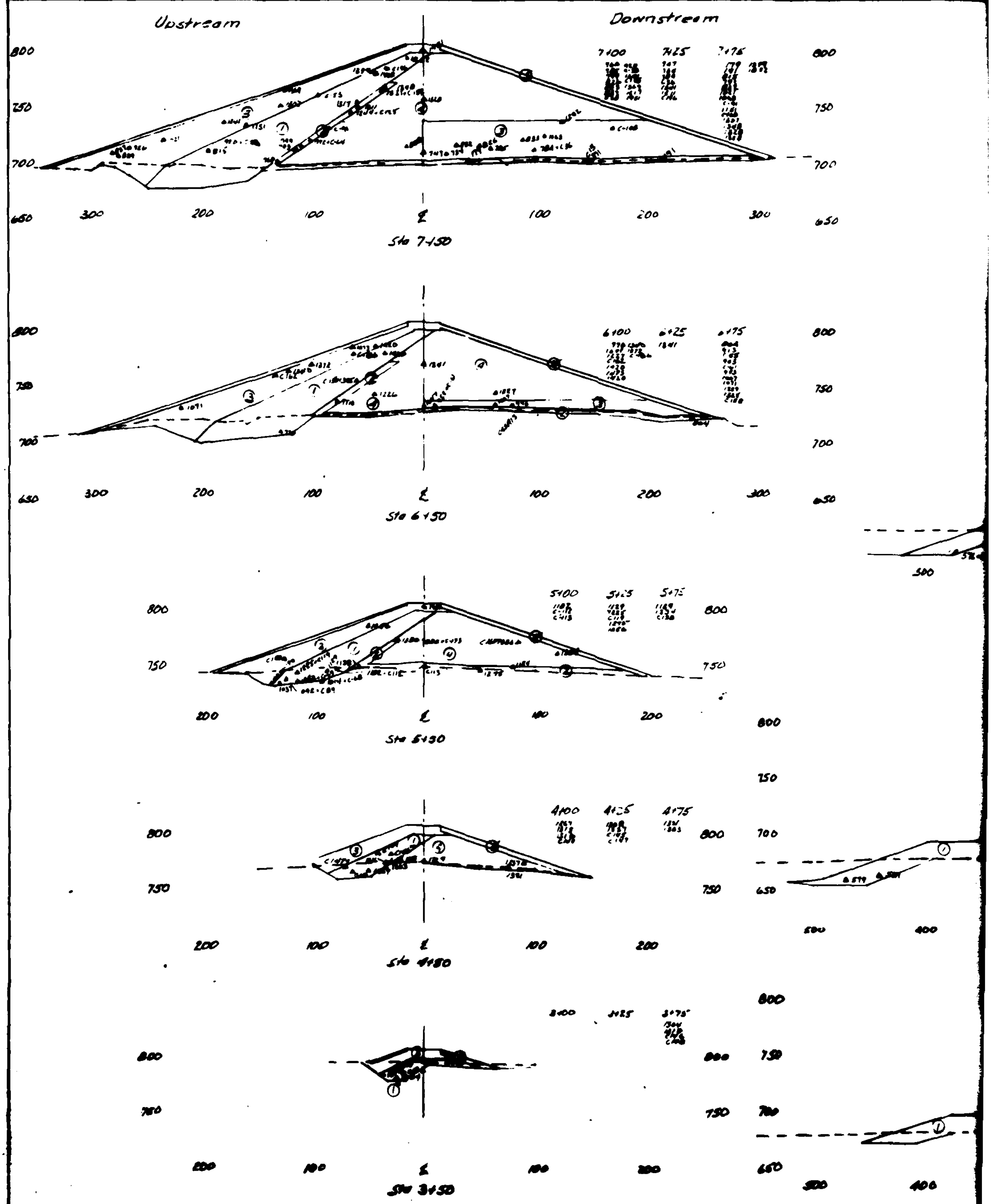
Field Control Test Locations

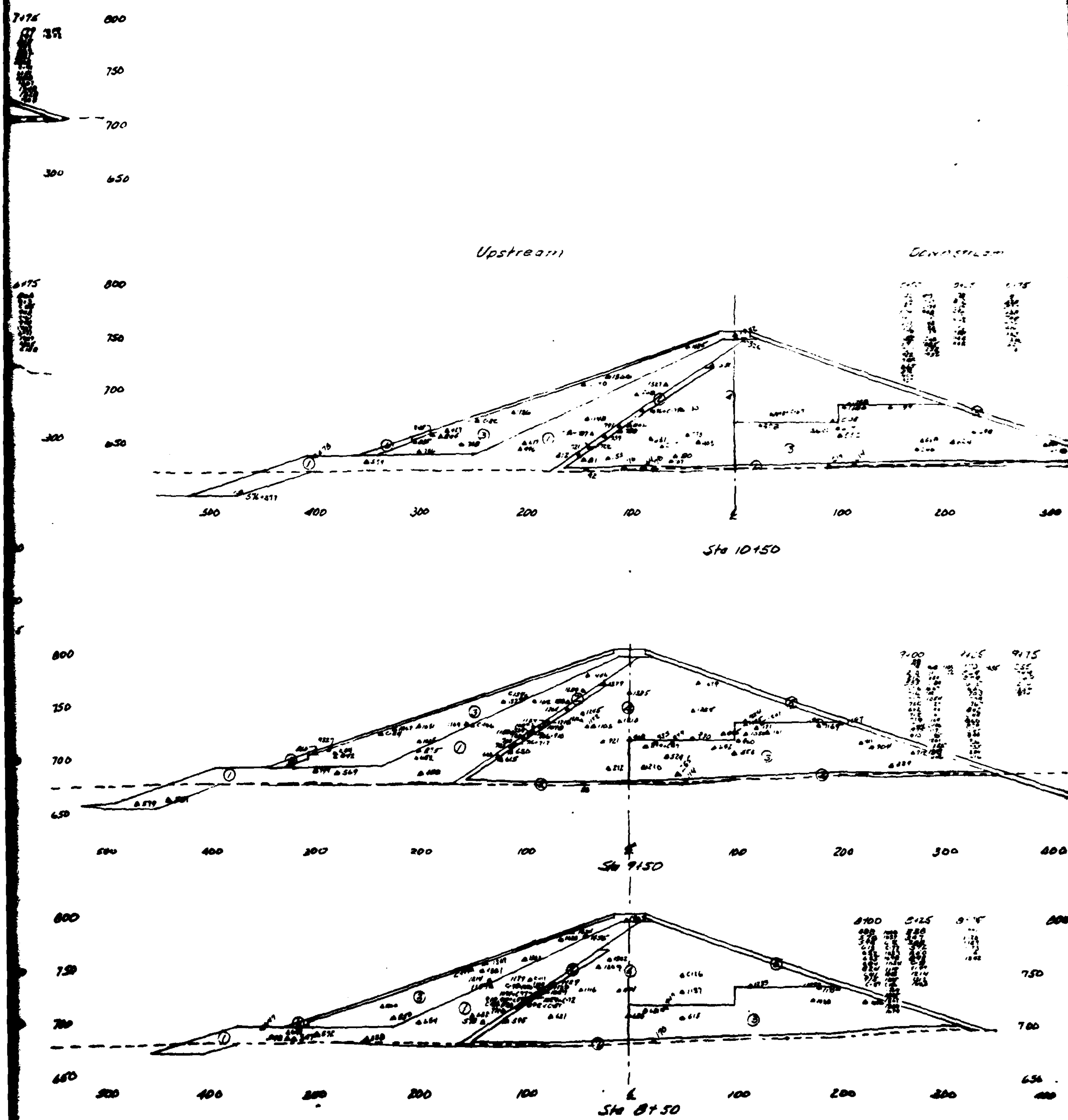
Scale Plate No

PLATE NO. 42

N 3

Corps of Engineers




Upstream
Downstream
Sta 10+50
Sta 9+50
Sta 8+50
800
750
700
650
500
400
300
200
100

1 2 1

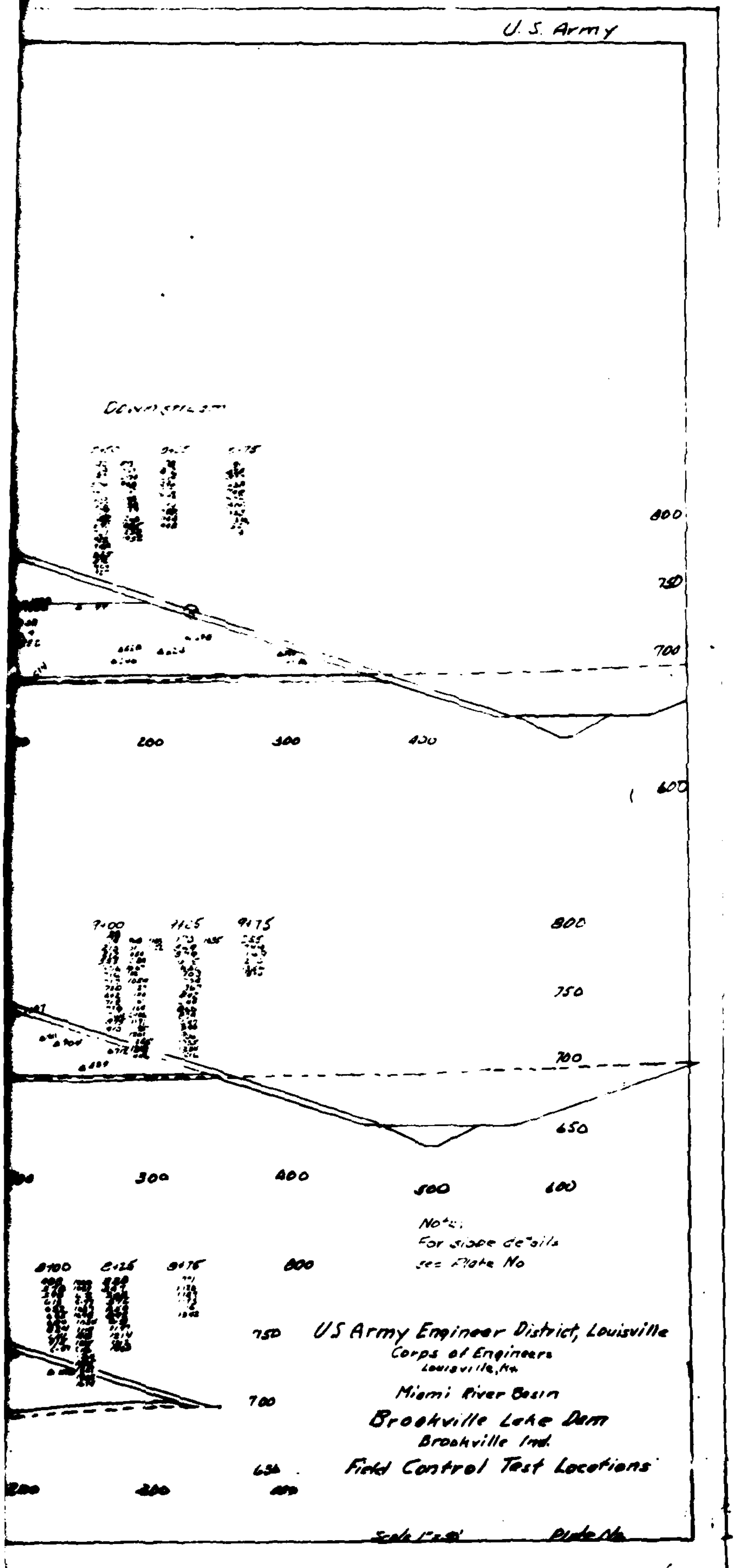
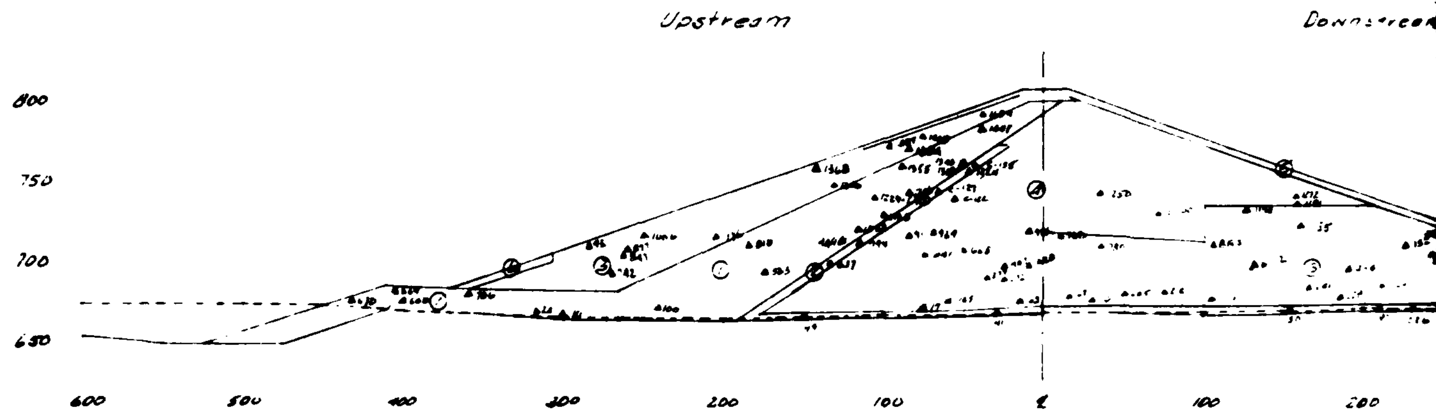
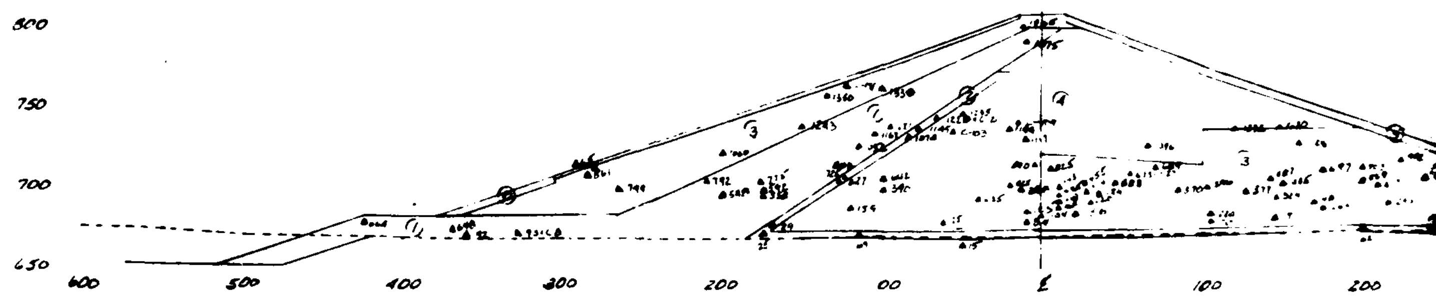

U.S. Army
800
750
700
200
300
400
600
7+00
9+75
800
750
700
650
300
400
500
600
Note:
For slope details see Plate No
8+00
8+25
8+75
800
750
700
US Army Engineer District, Louisville
Corps of Engineers
Louisville, Ky.
Miami River Basin
Brookville Lake Dam
Brookville Ind.
Field Control Test Locations
Plate No.

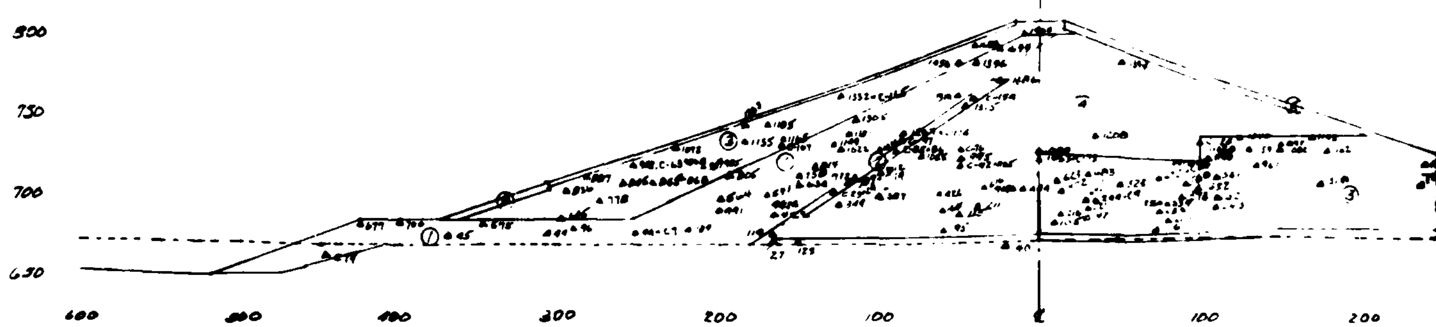
PLATE NO. 43



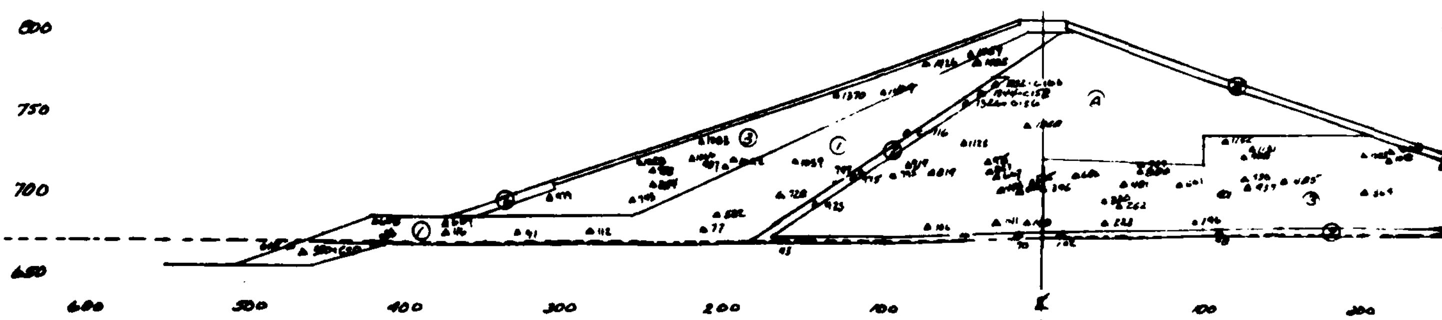
Sta 14+50



Sta 13+50



Sta 12+50



Sta 11+50

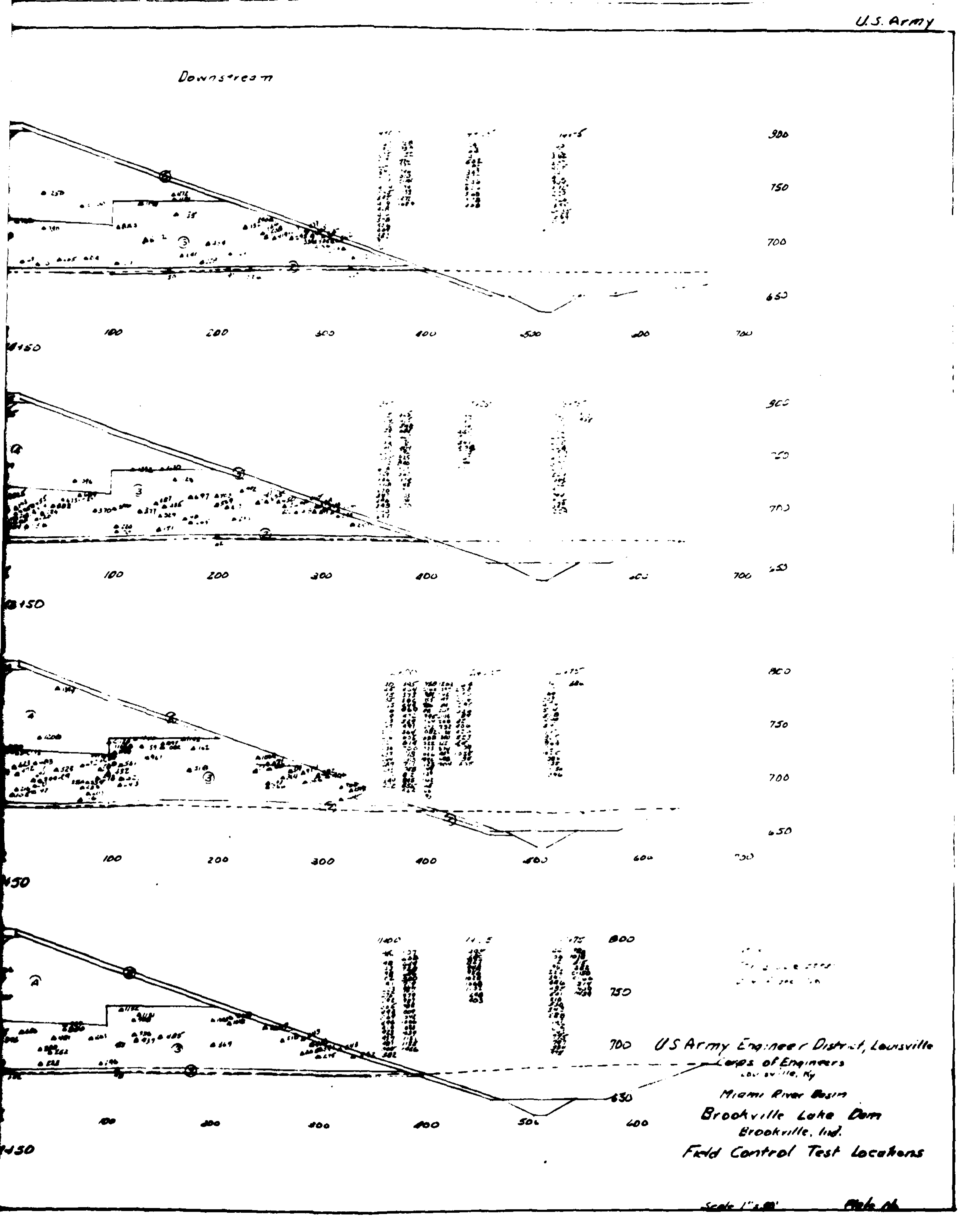
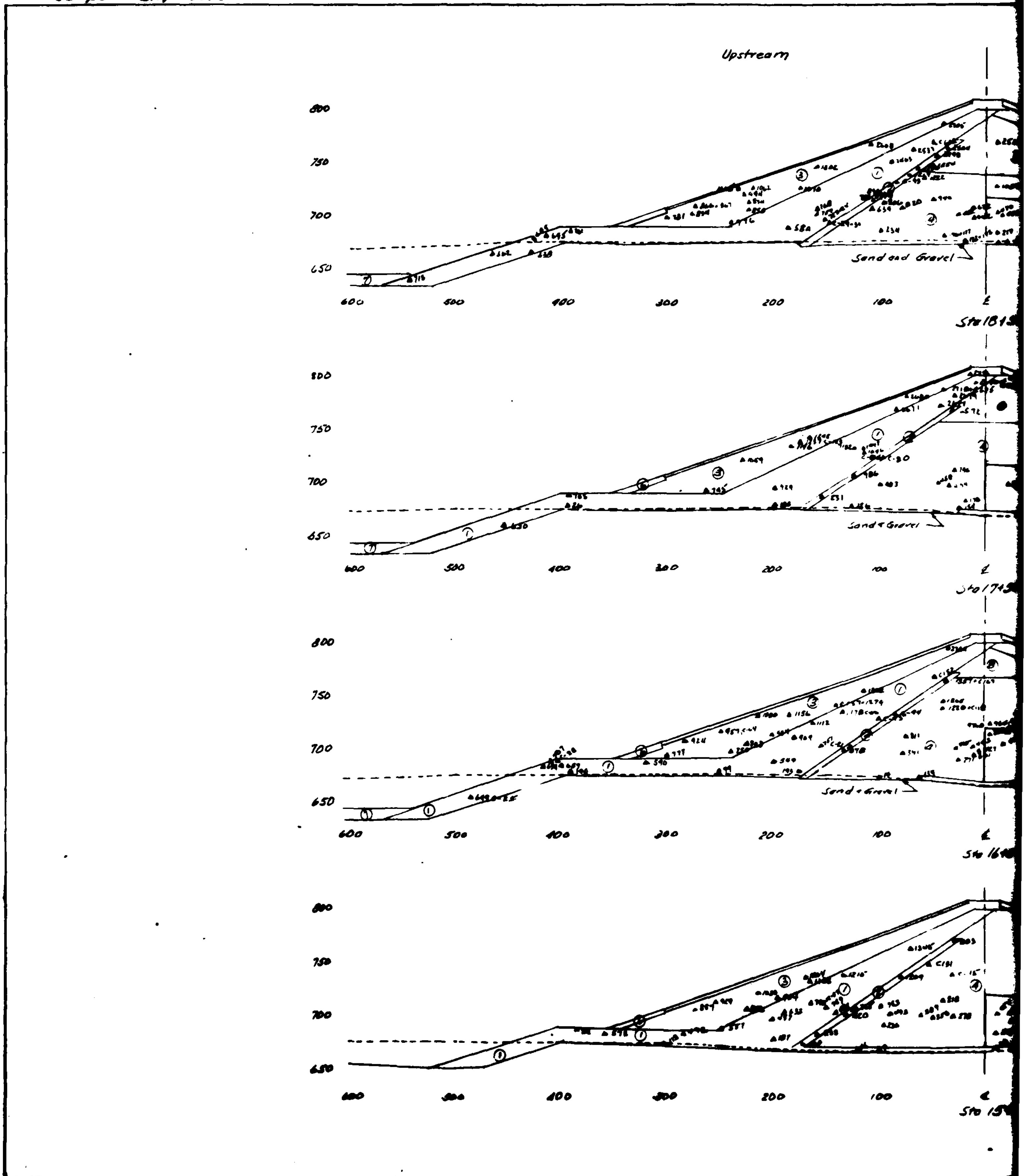
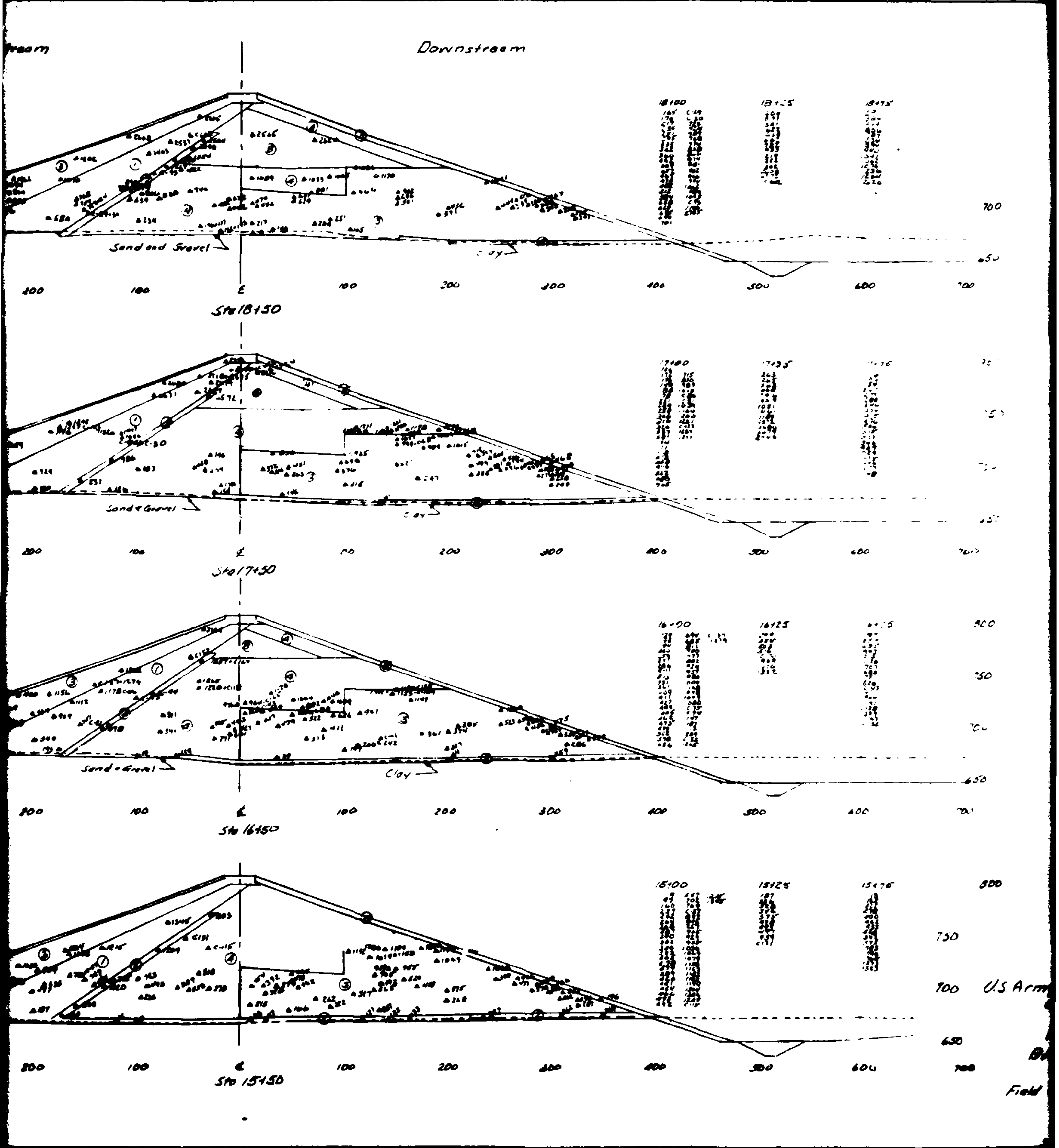

U.S. Army
Downstream
US Army Engineer District, Louisville
Corps of Engineers
Miami River Basin
Brookville Lake Dam
Brookville, Ind.
Field Control Test Locations

PLATE NO. 44

Corps of Engineers





Downstream
18+00
18+25
18+75
700
Sand and Gravel
Clay
200
100
100
200
300
400
500
600
Sta 18+50
17+00
Sand + Gravel
Clay
200
300
400
500
600
Sta 17+50
16+00
16+25
800
750
700
Sand + Gravel
Clay
650
200
100
100
200
300
400
500
600
Sta 16+50
15+00
15+25
800
750
700
650
200
100
100
200
300
400
500
600
700
Sta 15+50

2

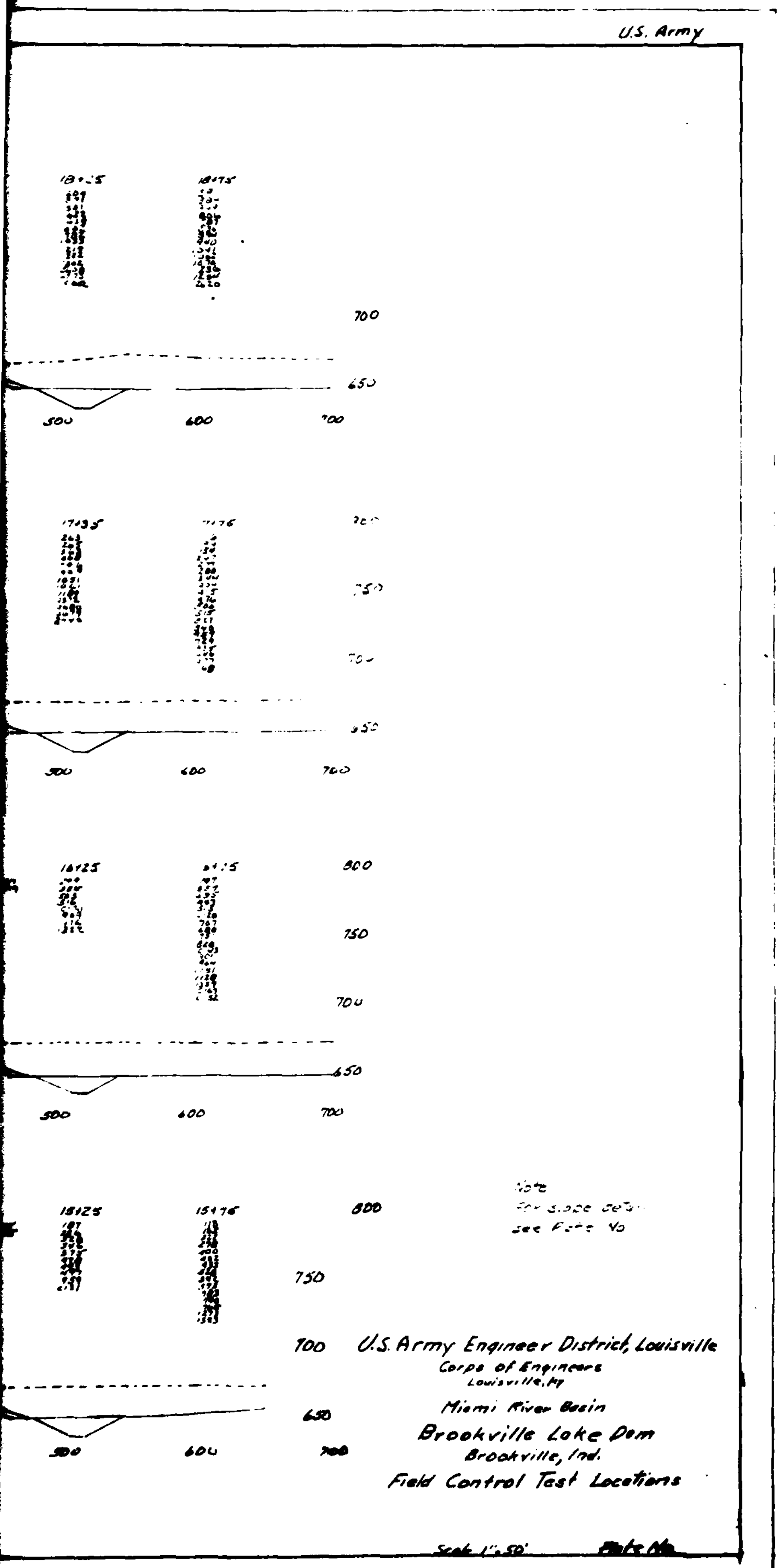
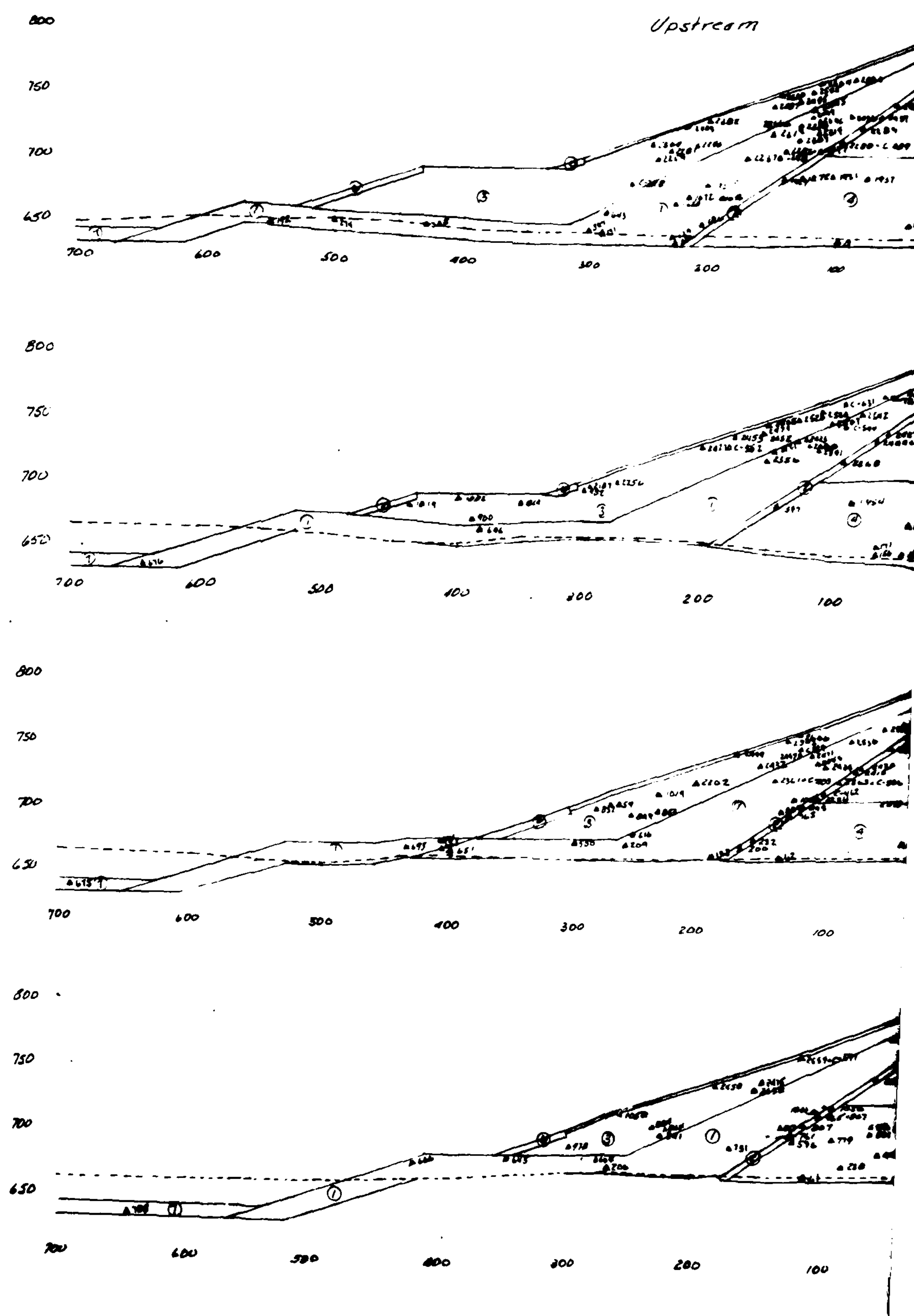
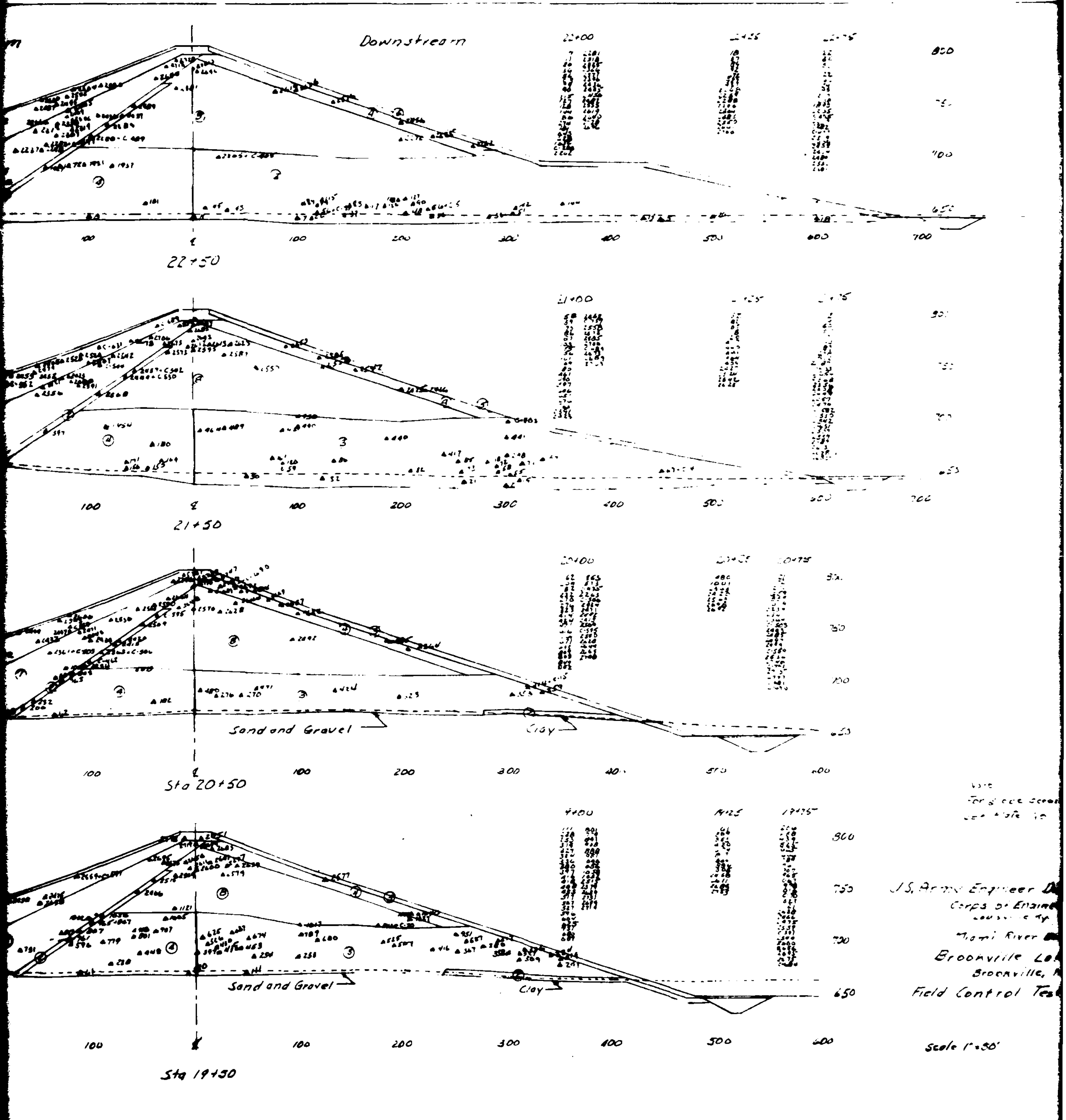

U.S. Army
700
650
500
600
700
750
800
Note
U.S. Army Engineer District, Louisville
Corps of Engineers
Louisville, Ky
Miami River Basin
Brookville Lake Dam
Brookville, Ind.
Field Control Test Locations
Scale 1" = 50'
Plate No.

PLATE NO. 45

Corps of Engineers



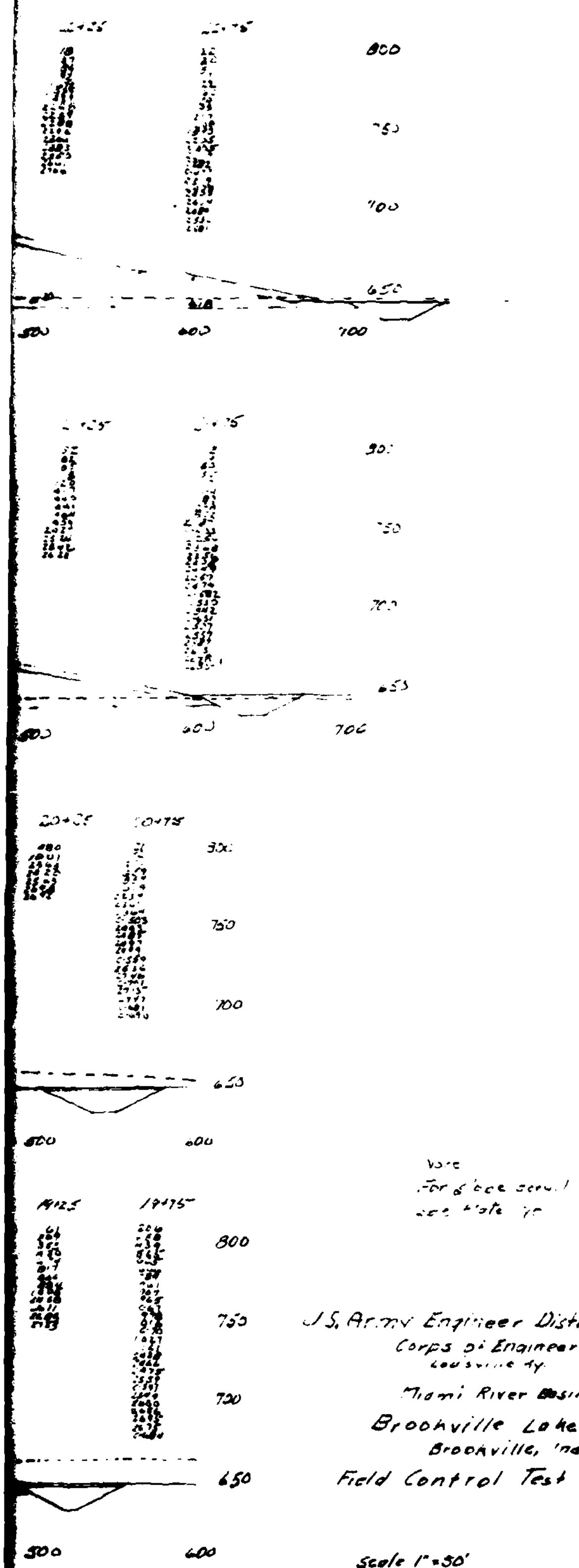


Downstream
22+50
21+50
Sand and Gravel
Clay
Sta 20+50
Sand and Gravel
Clay
Sta 19+50
Scale 1"=50'
Field Control Tes

2

1

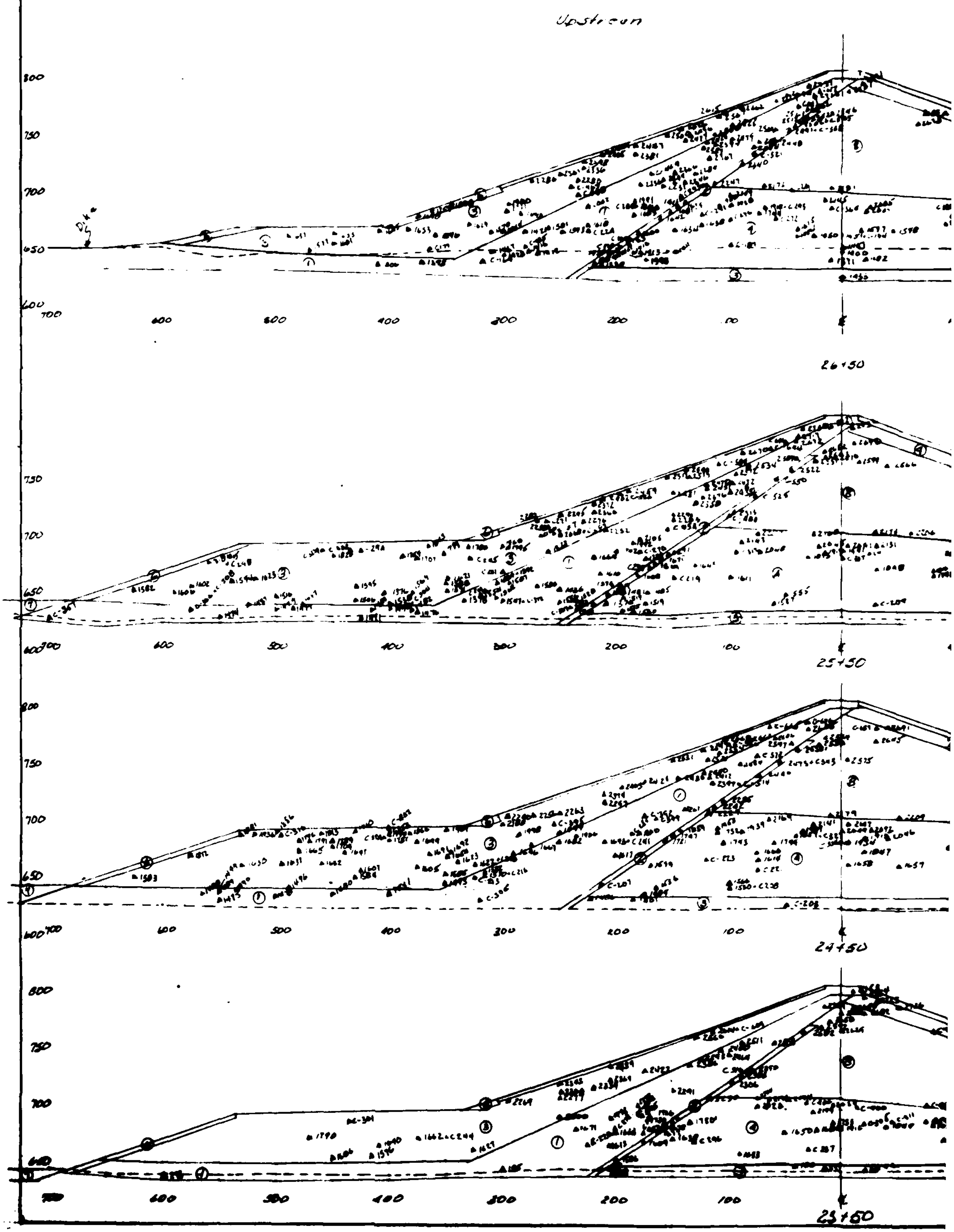
PLAT

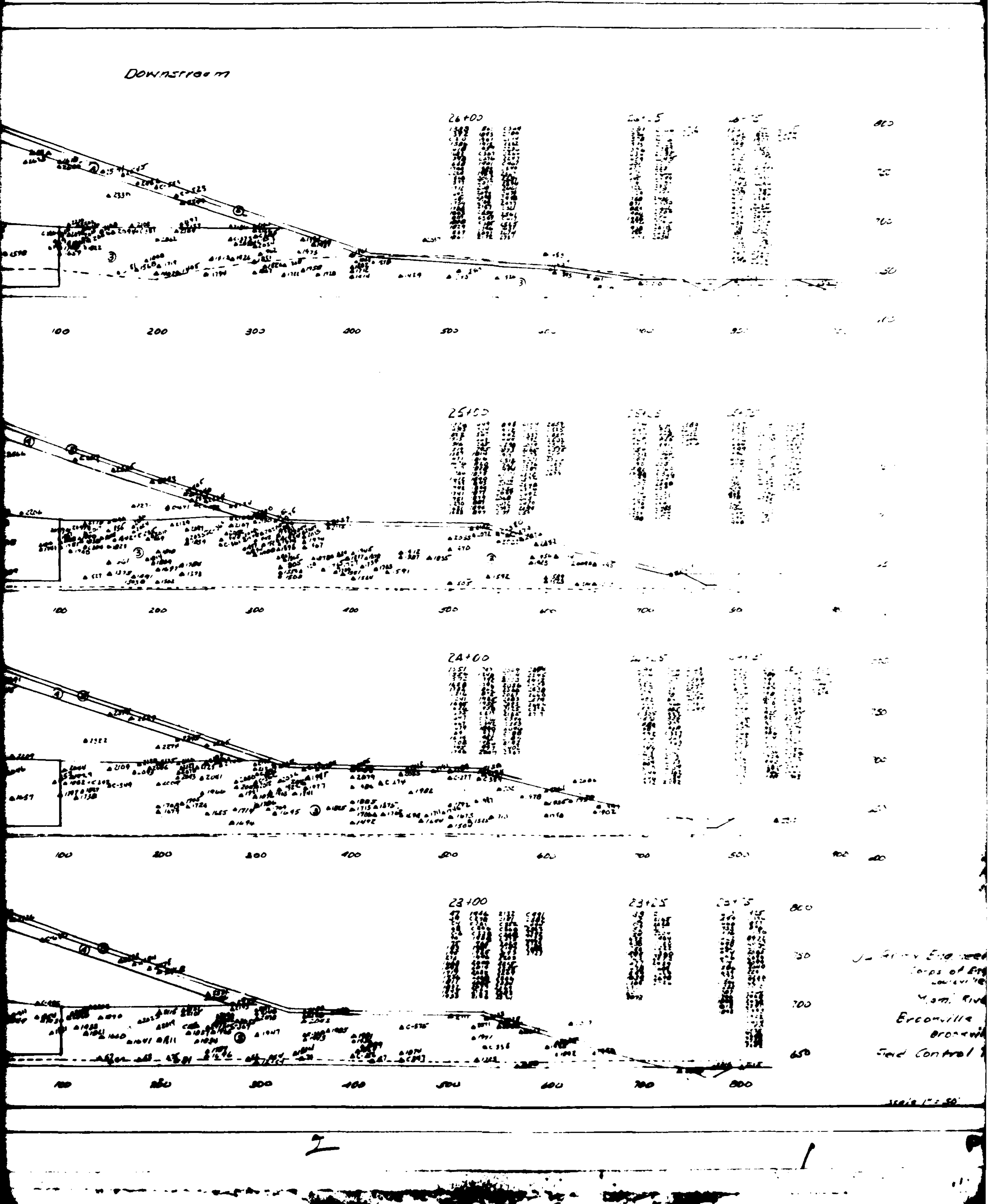


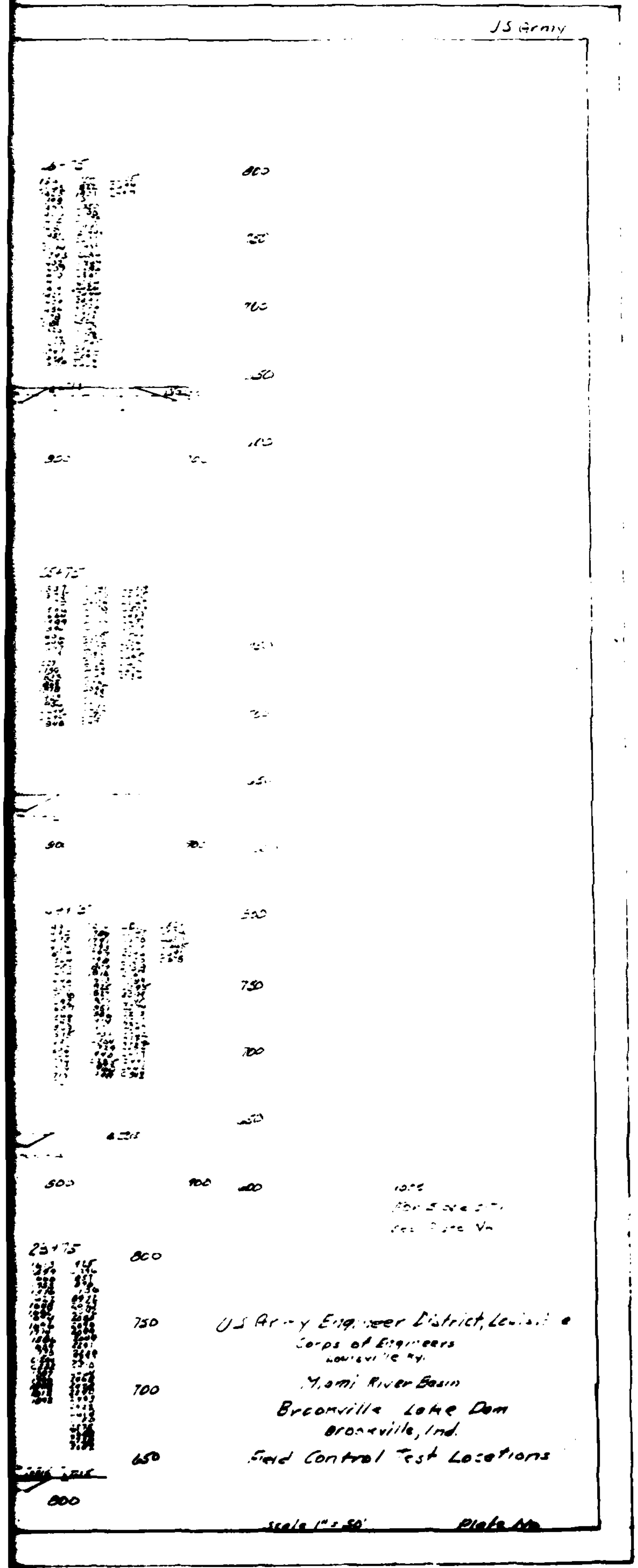
U.S. Army Engineer District, Louisville
Corps of Engineers
Louisville Ky.
Miami River Basin
Brookville Lake Dam
Brookville, Ind.
Field Control Test Locations

Scale 1" = 50'   Plate No

Corps of Engineers



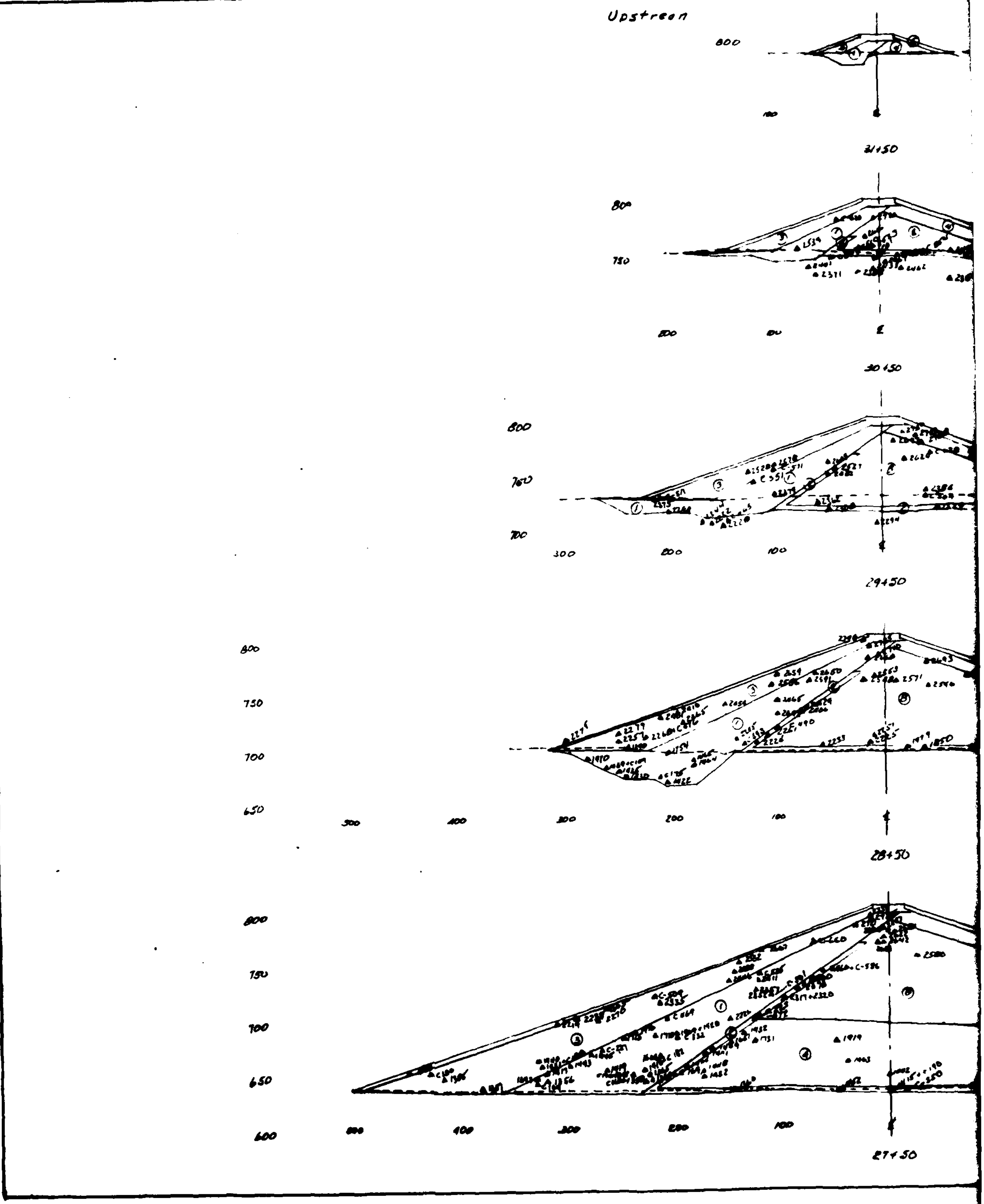

Downstream
26+00
25+00
24+00
23+00
23+25
100
200
300
400
500
800
750
700
650
Corps of Eng
Field Control

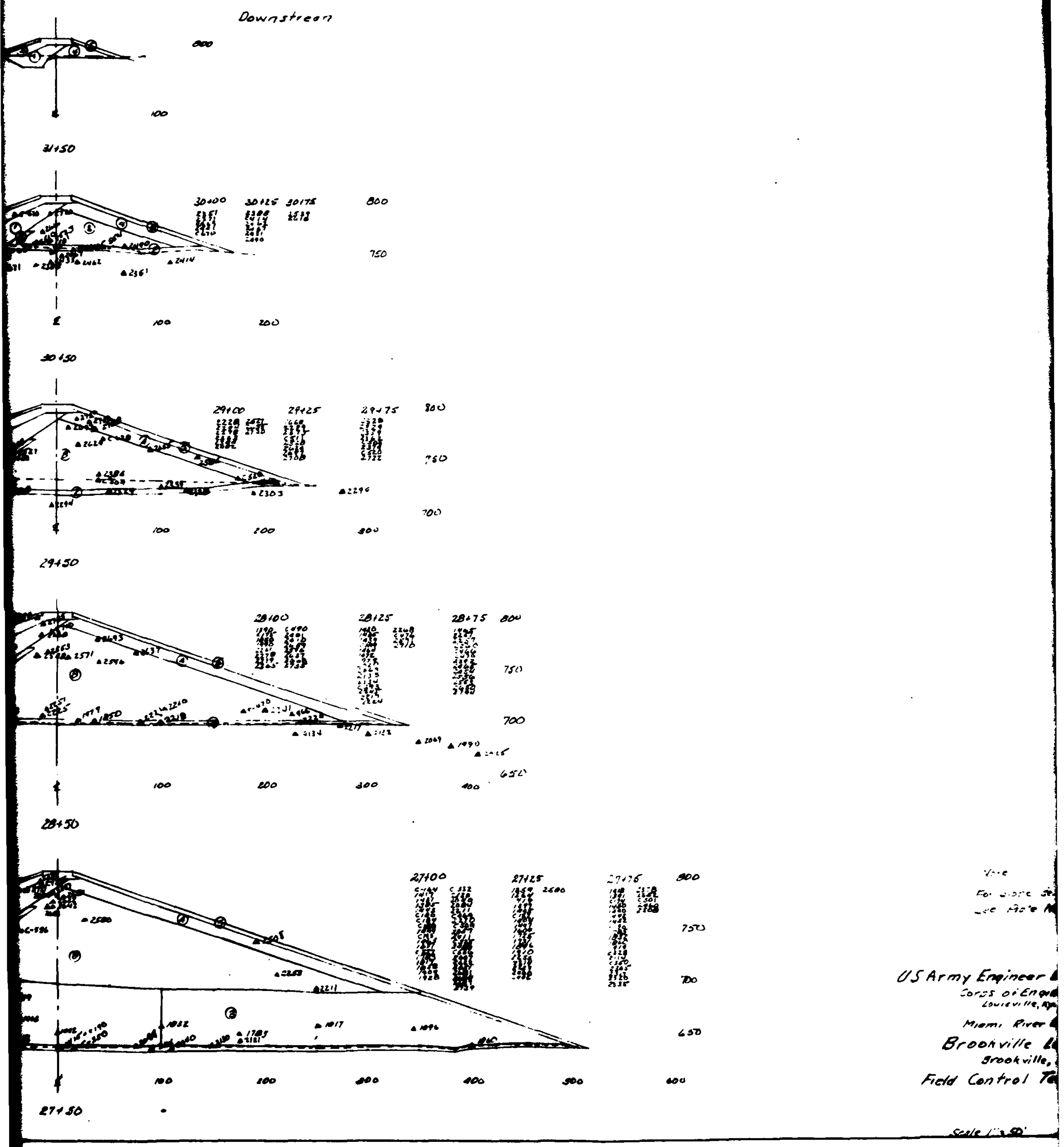


US Army
23+75
800
750
700
650
800
Corps of Engineers
Miami River Basin
Field Control Test Locations
Plate No

PLATE NO. 473

Corps of Engineers





Downstream
31+50
30+50
29+50
28+50
27+50
US Army Engineer
Miami River
Brookville
Field Control

2

US. Army

Note

For slope detail
see Plate No

US Army Engineer District, Louisville
Corps of Engineers
Louisville, Ky.

Miami River Basin

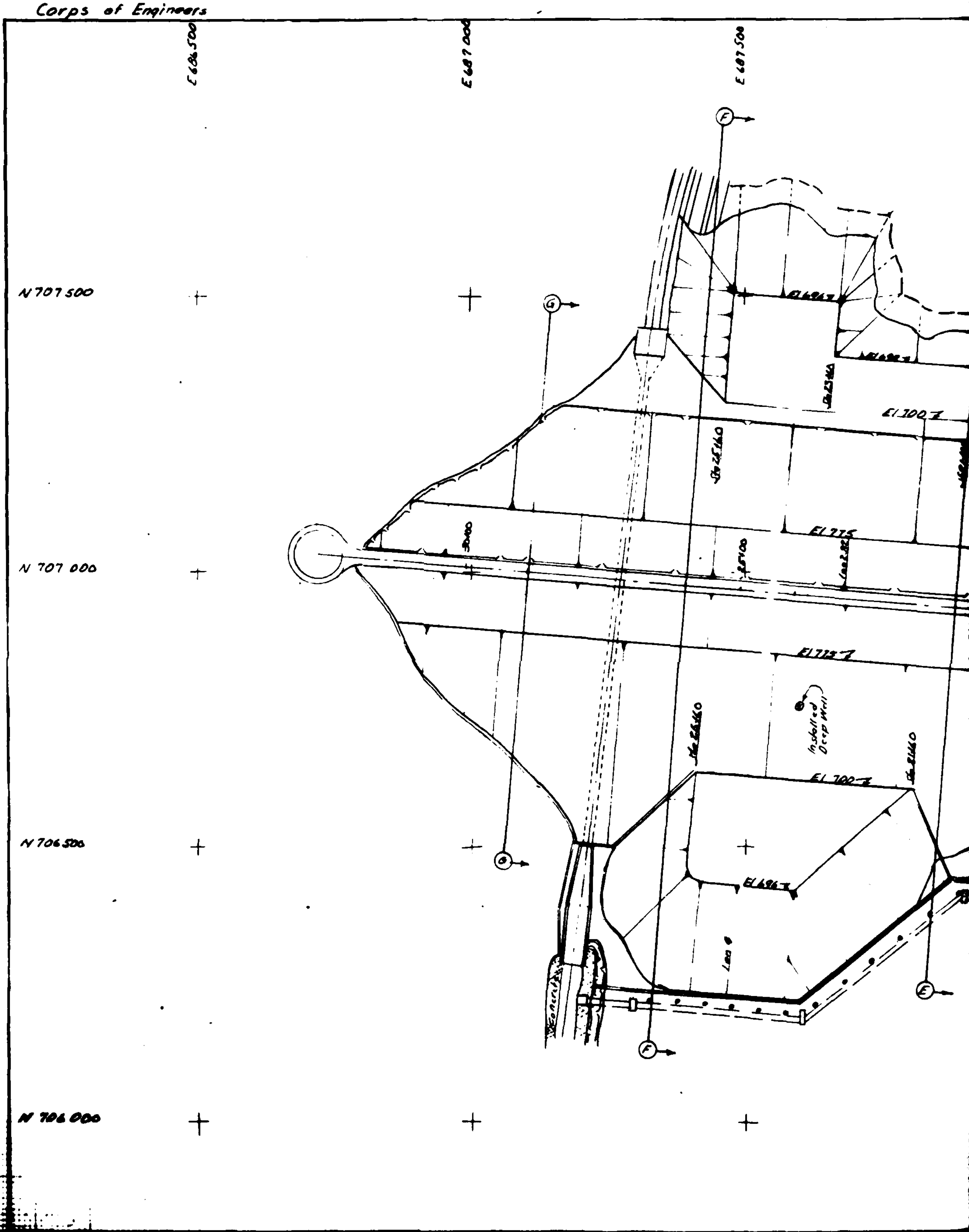
Brookville Lake Dam
Brookville, Ind

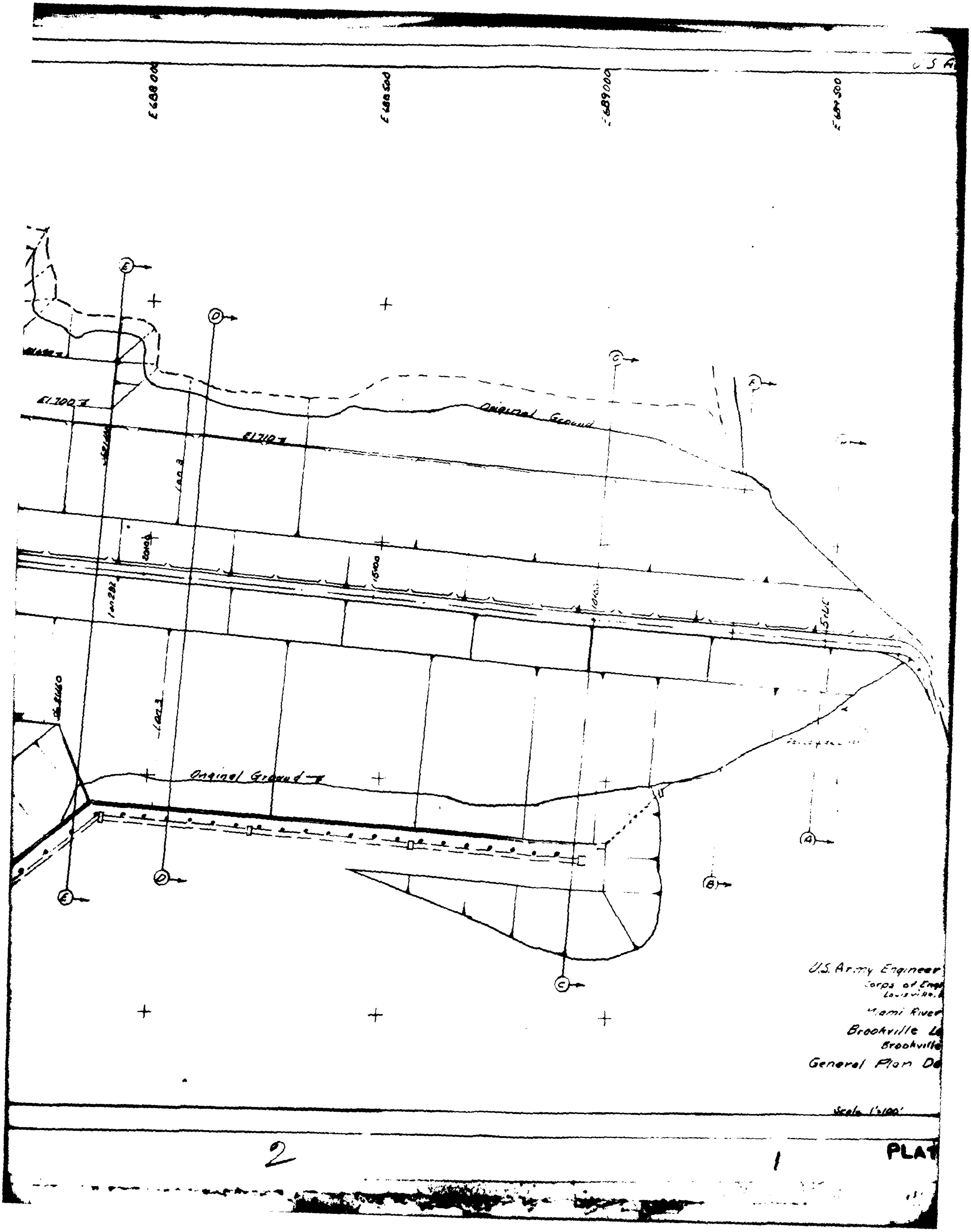
Field Control Test Locations

Scale 1" = 50' Plate No.

PLATE NO. 48

Corps of Engineers





E 688 000
E 688 500
E 689 000
E 689 500
El 700
El 710
Original Ground
Original Ground
U.S. Army Engineer
Miami River
Brookville
General Plan
Scale 1"=100'
2
1
PLAT

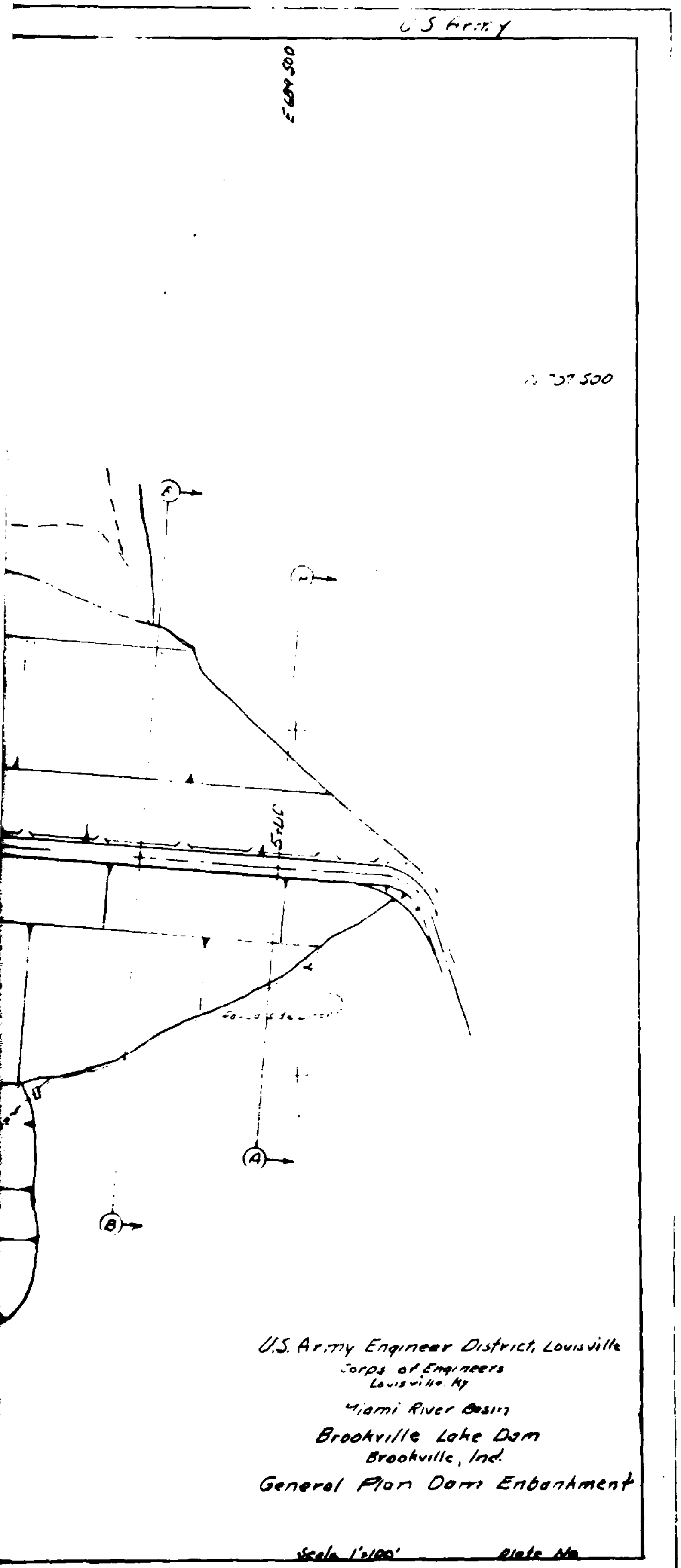
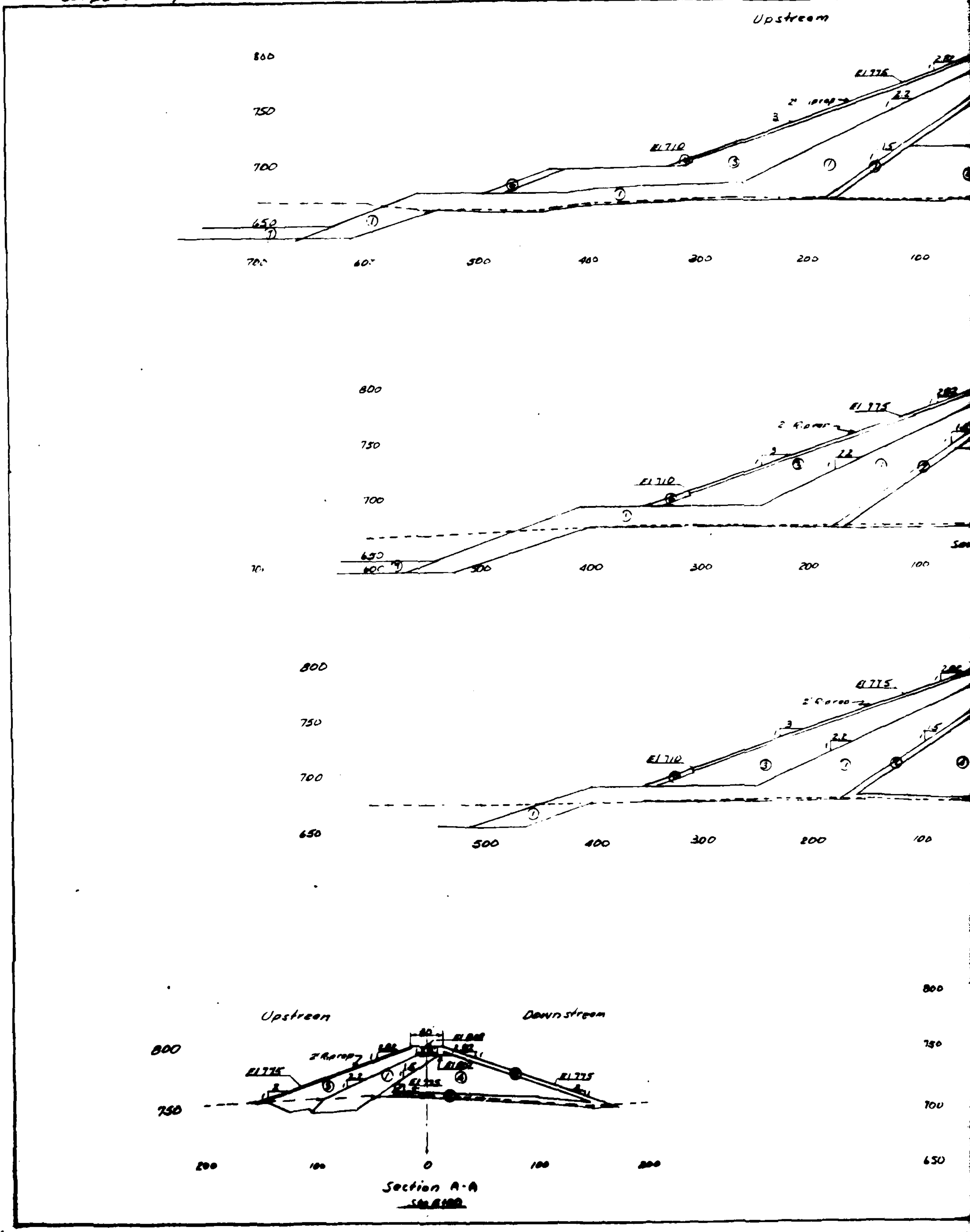
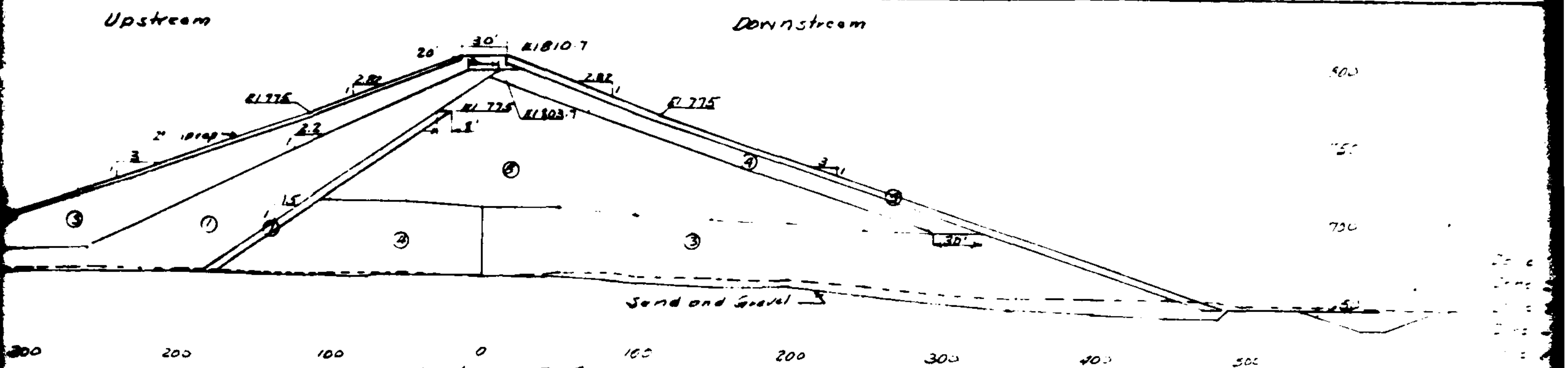

U.S. Army Engineer District, Louisville
Corps of Engineers
Louisville, Ky
Miami River Basin
Brookville Lake Dam
Brookville, Ind.
General Plan Dam Enbankment
Scale 1"=100'
Plate No.

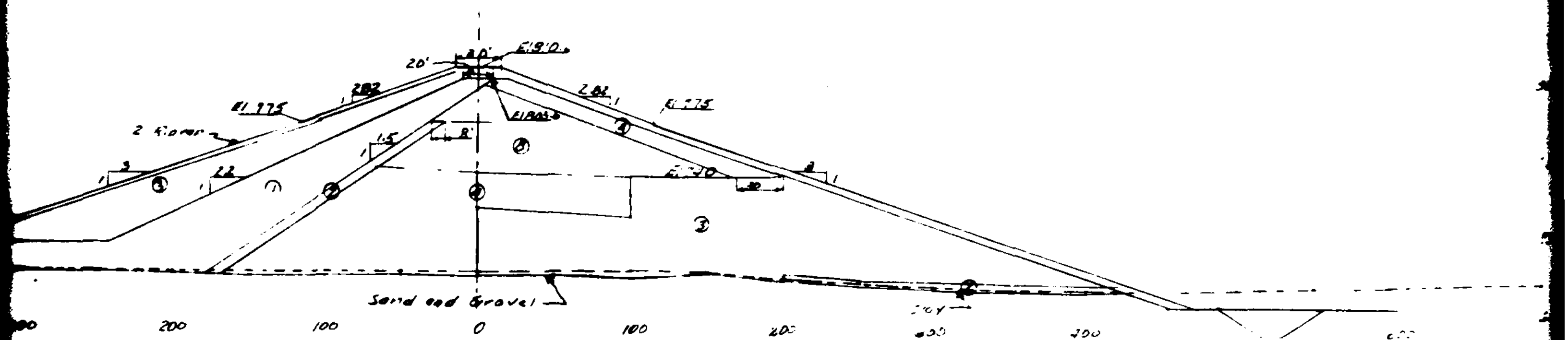
PLATE NO. 49

Corps of Engineers

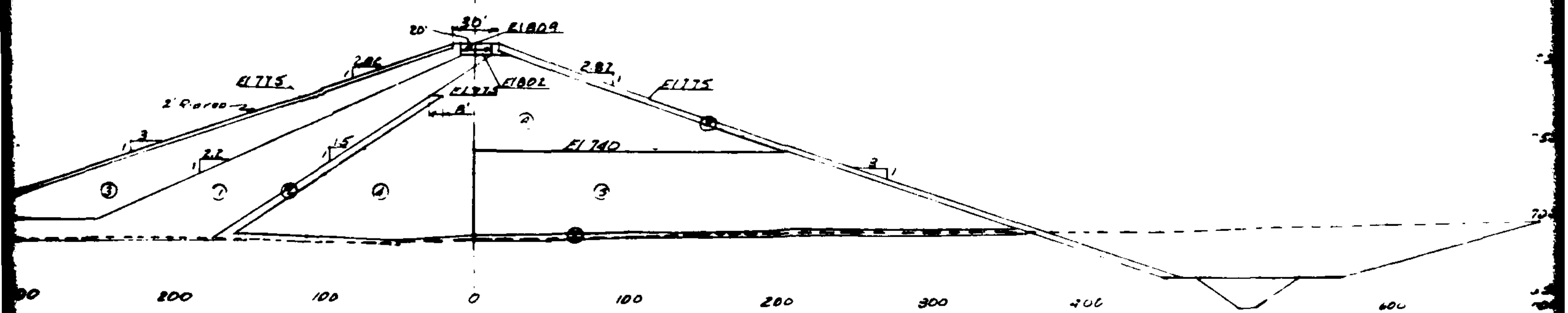




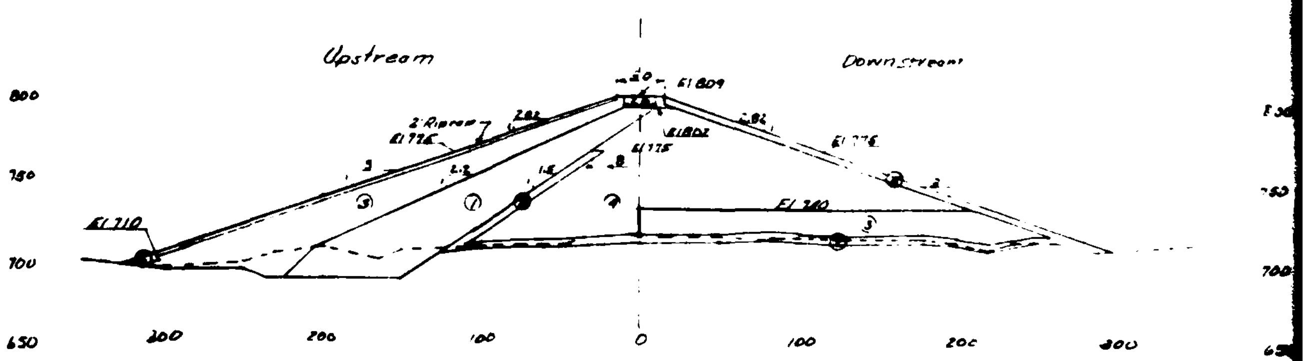
Section E-E
Sta 21+00



Section D-D
Sta 19+00



Section C-C
Sta 10+00



Section B-B
Sta 7+00

1

2

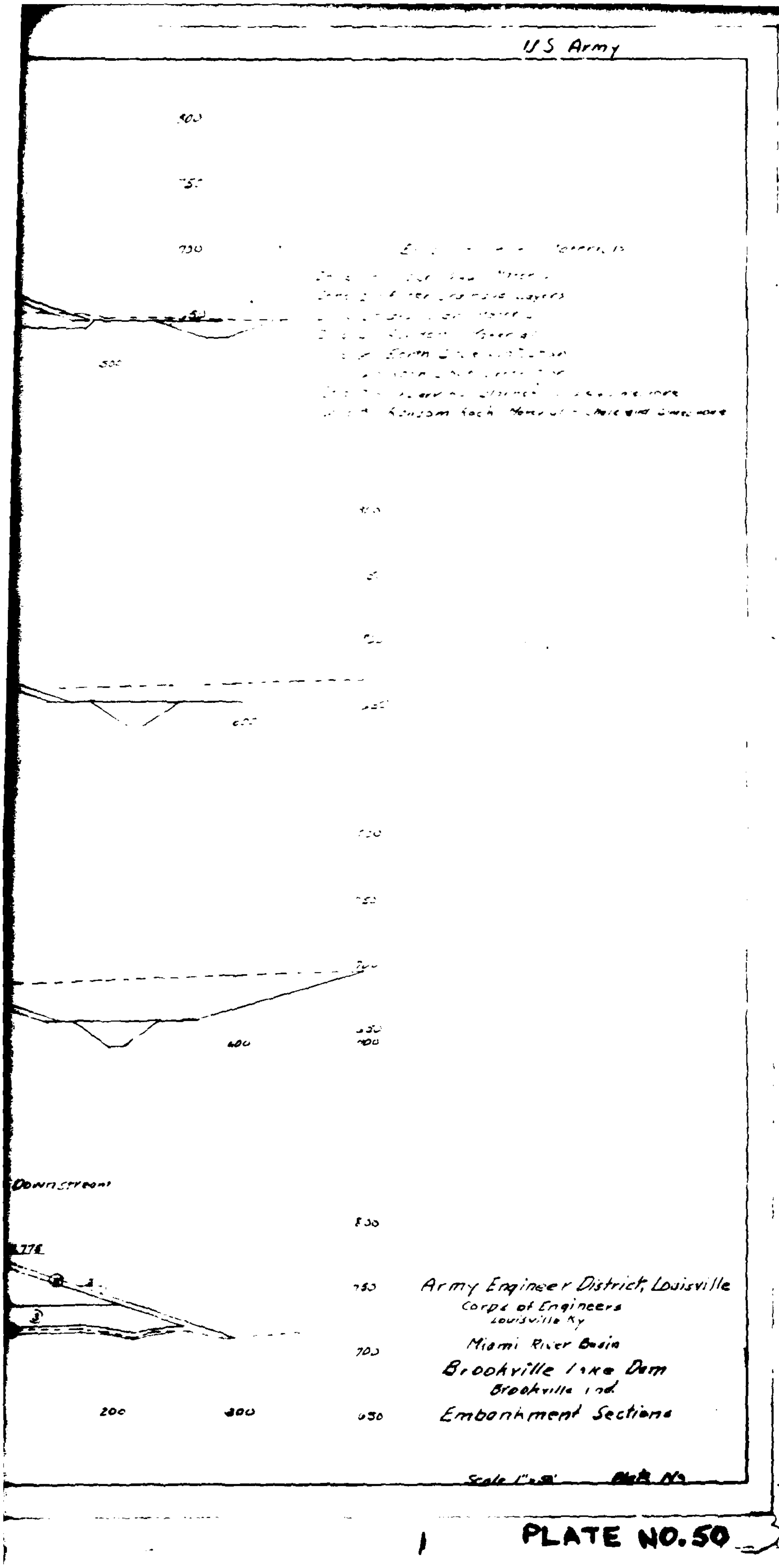
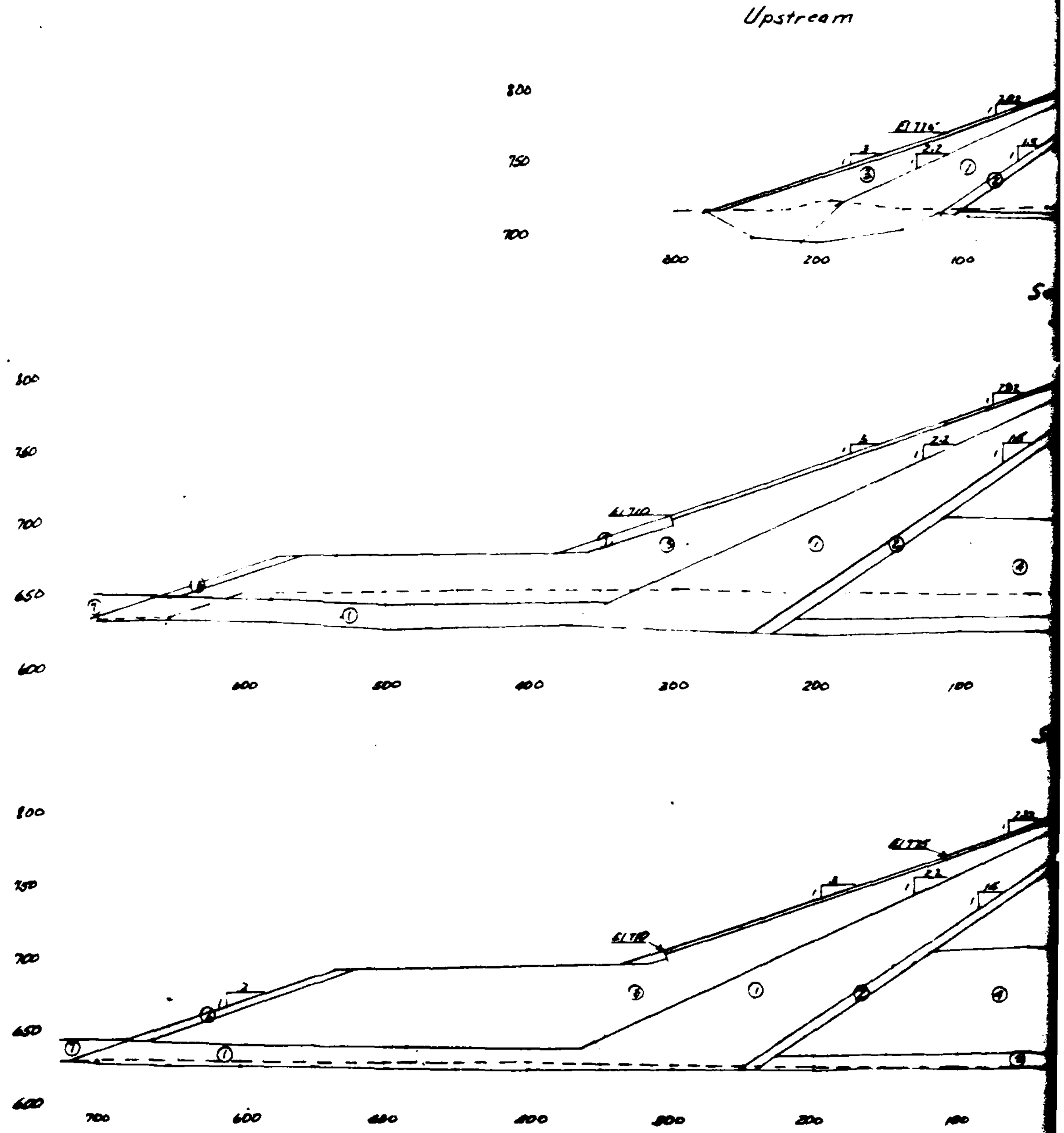
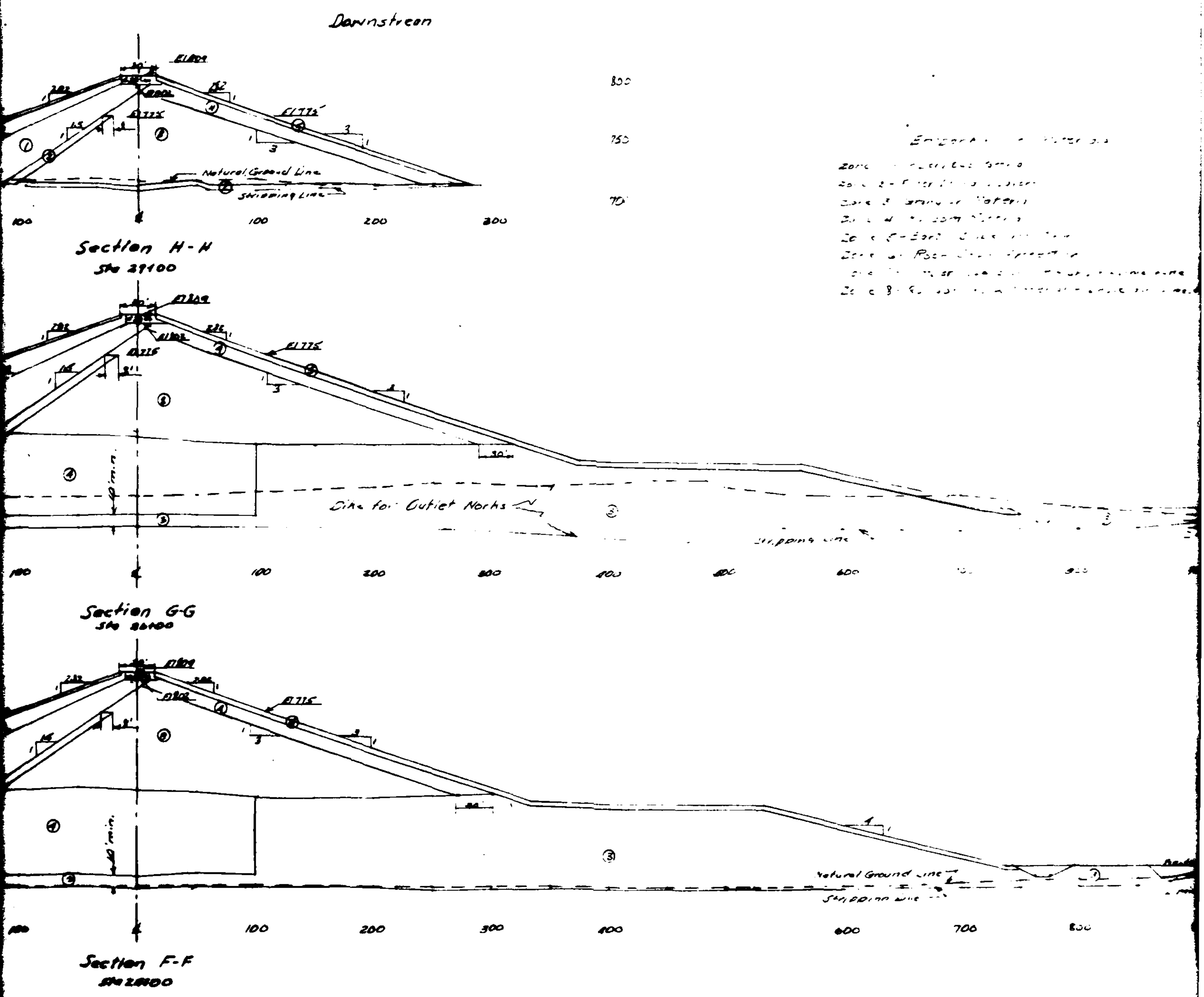

US Army
Downstream
200
400
600
650
700
750
800
Army Engineer District, Louisville
Corps of Engineers
Louisville Ky
Miami River Basin
Brookville Lake Dam
Brookville Ind.
Embankment Sections

PLATE NO. 50

Corps of Engineers





U.S. Army Engineer Distr

Corps of Engineers
Louisville Ky

Miami River Basi

Brookville Lake

Brookville, Ind

Embankment Sec

Scale 1"=60'

PLATE

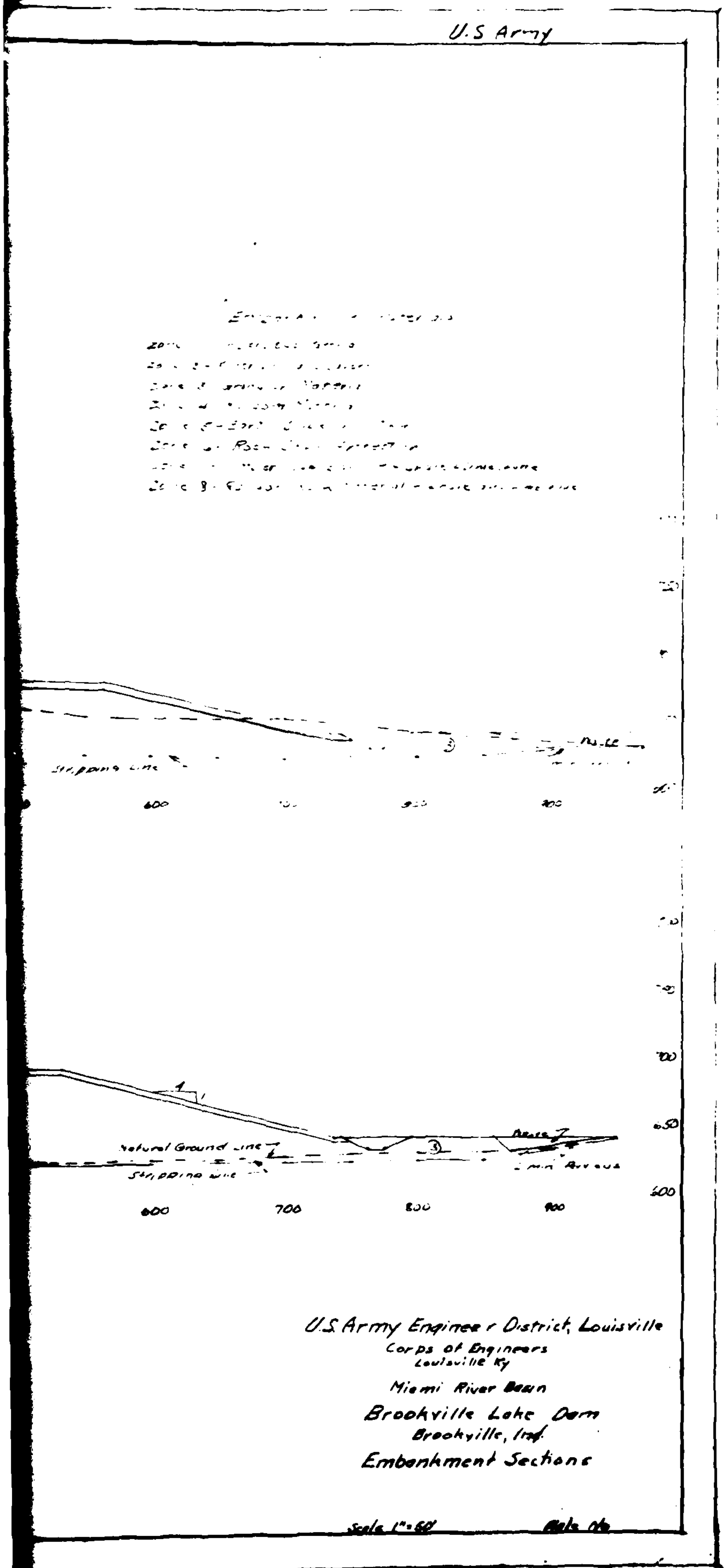

U.S Army
Natural Ground Line
Stripping Line
600
700
800
900
U.S. Army Engineer District, Louisville
Corps of Engineers
Louisville Ky
Miami River Basin
Brookville Lake Dam
Brookville, Ind.
Embankment Sections
Scale 1"=60'

PLATE NO. 51

CONTRACTOR FIELD COM

MATERIAL (ZONE)	NUMBER OF TESTS	DRY DENSITY				PERCENT C		
		HIGH	LOW	AVERAGE	DESIGN	HIGH	LOW	AV
IMPERVIOUS	158 *	139.9	91.0	108.7	110.0	112.4	85.1	
RANDOM	90 **	145.9	99.7	129.4	127.5	102.0	56.0	
PERVIOUS	464 ***	157.7	107.5	135.4	125.0	100.0	20.0	

* OF THE 158 TESTS RUN ON THE IMPERVIOUS MATERIAL 36
OPTIMUM, 9 TESTS INDICATED THE MATERIAL WAS TOO D
BELOW THE COMPACTION DESIRED). ALL OF THE TEST SEC
THAT WERE RETESTED AND ALL THESE TESTS WERE A

** OF THE 90 TESTS RUN ON THE RANDOM MATERIAL 7 TESTS
COMPACTION DESIRED). ALL OF THE TEST SECTIONS TH
ALL THESE TESTS WERE ACCEPTABLE.

*** OF THE 464 TESTS RUN ON THE PERVIOUS MATERIAL
THE COMPACTION DESIRED). ALL OF THE TEST SEC
THAT WERE RETESTED AND ALL THESE TESTS WERE

CORPS OF ENGINEERS ACCE

MATERIAL (ZONE)	NUMBER OF TESTS	DRY DENSITY				PERCENT		
		HIGH	LOW	AVERAGE	DESIGN	HIGH	LOW	AV
IMPERVIOUS	7 *	114.9	99.8	110.3	110.0	102.0	99.0	
PERVIOUS	20 **	146.4	103.9	124.9	125.0	100.0	6.0	

* OF THE 7 TESTS RUN ON THE IMPERVIOUS MATERIAL 0 TEST

** OF THE 20 TESTS RUN ON THE PERVIOUS MATERIAL 8 TEST
COMPACTION DESIRED). ALL OF THE TEST SECTIONS THAT F
AND ALL THESE TESTS WERE ACCEPTABLE.

Brookville

① STANDARD PROCTOR TEST USED ON THE IMPERVIOUS MATERIAL
② NOT APPLICABLE - NO MOISTURE CONTROL SPECIFIED
③ INDICATE RESULTS OF ALL TESTS FOR HIGH AND LOW VALUES A

TOR FIELD COMPACTION CONTROL - DAM

	PERCENT COMPACTION ① ③				WATER CONTENT ③				DEVIATION FRO[M]		
N	HIGH	LOW	AVERAGE	DESIRED	HIGH	LOW	AVERAGE	DESIGN	HIGH	LOW	AVE[RAGE]
D	112.4	85.1	98.2	95.0	28.9	3.5	17.4	15.0	+8.9	-10.0	+ [illegible]
5	102.0	56.0	94.5	85.0	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/[A]
D	100.0	20.0	94.7	85.0	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/[A]

MATERIAL 36 TESTS FAILED (11 TESTS INDICATED THE MATERIAL WAS TO
IAL WAS TOO DRY OF OPTIMUM AND 16 TESTS INDICATED THE MATERIA
F THE TEST SECTIONS THAT FAILED WERE REWORKED. THE WERE 14
TESTS WERE ACCEPTABLE.

TERIAL 7 TESTS FAILED (ALL TESTS INDICATED THE MATERIAL WAS BEL
T SECTIONS THAT FAILED WERE REWORKED. ALL AREAS WERE RETESTE

IOUS MATERIAL 27 TESTS FAILED (ALL TESTS INDICATED THE MATERIAL
THE TEST SECTIONS THAT FAILED WERE REWORKED. THERE WERE 2
TESTS WERE ACCEPTABLE.

F ENGINEERS ACCEPTANCE TESTS - DAM

	PERCENT COMPACTION ① ③				WATER CONTENT ③				DEVIATION FROM		
N	HIGH	LOW	AVERAGE	DESIRED	HIGH	LOW	AVERAGE	DESIGN	HIGH	LOW	AVER[AGE]
D	102.0	99.0	100.6	95.0	23.0	13.6	17.0	15.0	+1.5	-2.9	-1.[illegible]
D	100.0	6.0	77.8	85.0	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/[A]

ATERIAL 0 TESTS FAILED.

ATERIAL 8 TESTS FAILED (ALL TESTS INDICATED THE MATERIAL WAS BEL
ECTIONS THAT FAILED WERE REWORKED. THERE WERE 6 AREAS THAT WER
LE.

RVIOUS MATERIAL, RELATIVE DENSITY TEST USED ON THE RANDOM AND PERVIOUS
SPECIFIED
ND LOW VALUES AND INDICATE RESULTS OF ACCEPTABLE TESTS AND RETESTS FOR

1 2

③	DEVIATION FROM OPTIMUM ③			
IGN	HIGH	LOW	AVERAGE	SPECIFIED
5.0	+8.9	-10.0	+ .15	-2.0 +2.0
/A ②	N/A ②	N/A ②	N/A ②	N/A ②
/A ②	N/A ②	N/A ②	N/A ②	N/A ②

E MATERIAL WAS TOO WET OF
ATED THE MATERIAL WAS
D. THE WERE 14 AREAS

MATERIAL WAS BELOW THE
EAS WERE RETESTED AND

ED THE MATERIAL WAS BELOW
D. THERE WERE 24 AREAS

③	DEVIATION FROM OPTIMUM ③			
SIGN	HIGH	LOW	AVERAGE	SPECIFIED
5.0	+1.5	-2.9	-1.04	-2.0 +2.0
N/A ②	N/A ②	N/A ②	N/A ②	N/A ②

MATERIAL WAS BELOW THE
6 AREAS THAT WERE RETESTED

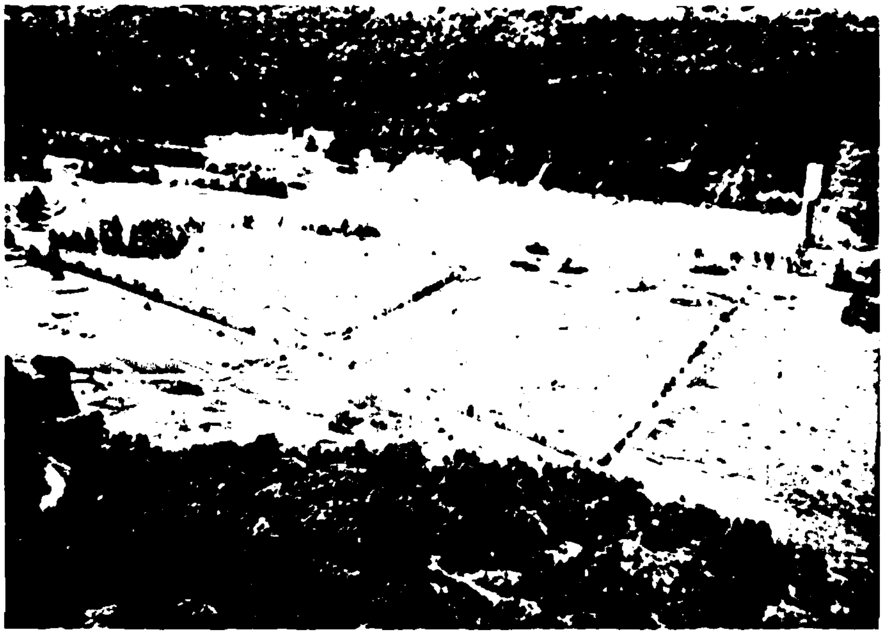
RANDOM AND PERVIOUS MATERIAL

ESTS AND RETESTS FOR AVERAGE VALUES

PLATE 52

3

Foundation Photographs

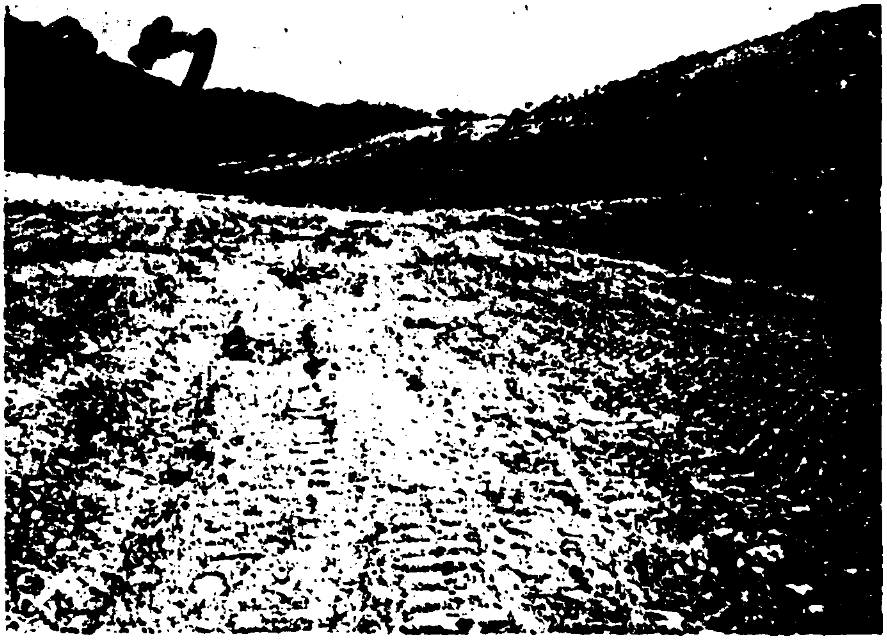


1. Typical view of dam area from left abutment to prior stripping.

2. View of left abutment cutoff trench back station from 2+00 (9/15/70).

3. View looking back at embankment rolling from Station 20+75. Top of embankment is elevation 672 (8/14/70).

4. View looking U.S. from ℄ dam Station 22+50 (8/14/70).



5. View looking upstream from ℄ dam Station 22+50 at embankment tie to the abutment (8/14/70).

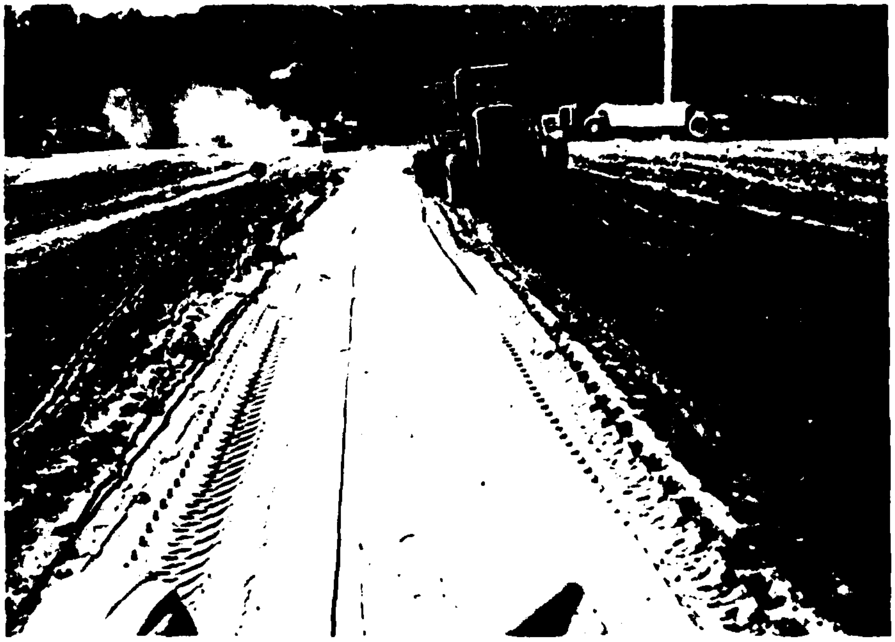
6. View of right abutment cutoff trench foundation from Station 30+00 ahead during excavation (10/6/70).

7. Typical right abutment cutoff trench foundation (5/27/72).

8. Disking dry impervious fill material (9/1/70).

9. Typical operation of placing incline drain material (9/1/70).

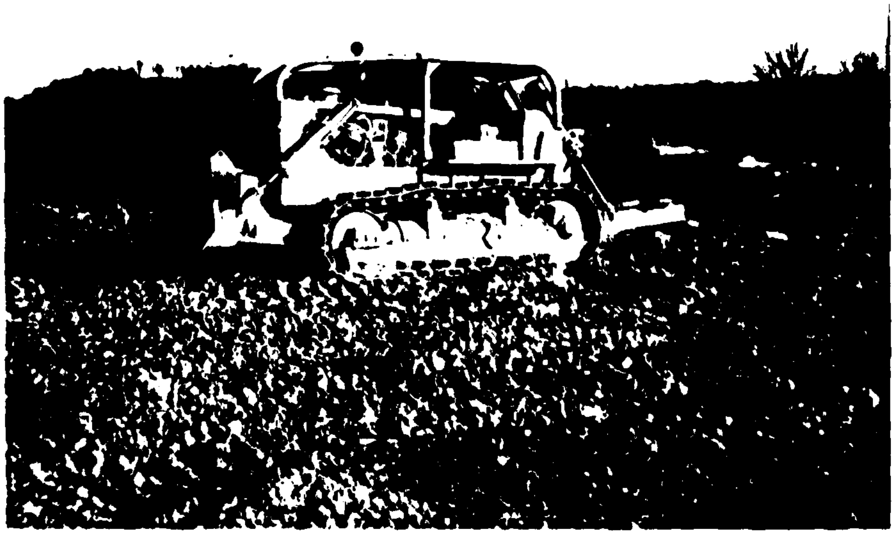
10. Rolling incline drain material @ Station 17+00 (9/1/70).



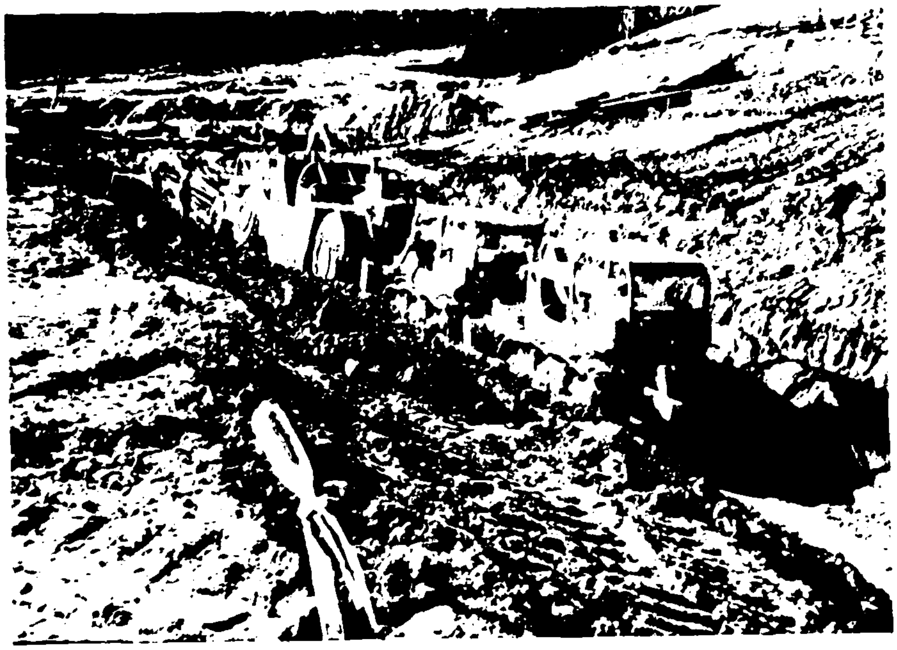
11. View of inclined drain zone after being rolled (9/1/70).

12. Adding moisture to dam foundation material prior to rolling @ 75 feet left of Station 200+00.

13. Adding moisture to dry impervious material (9/1/70).

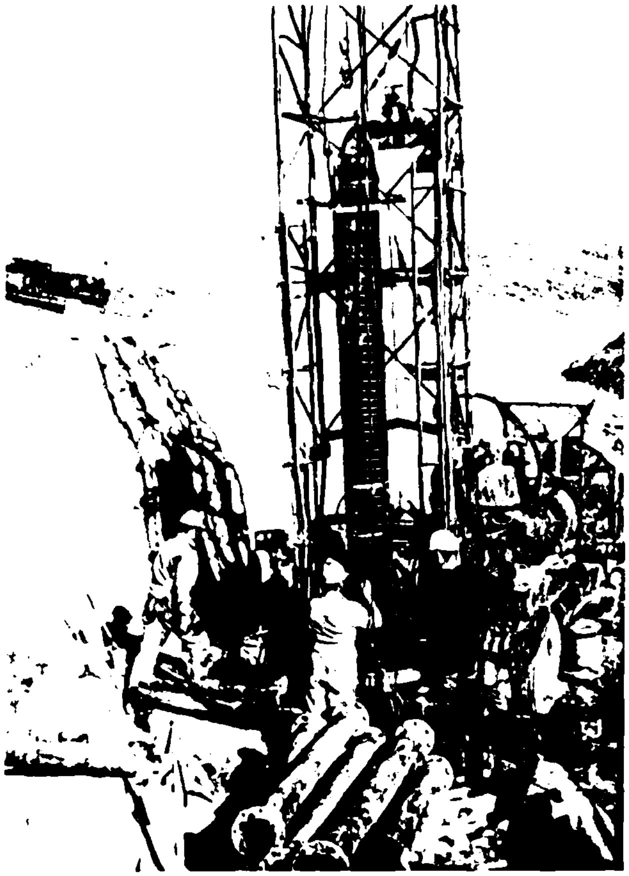


14. Ripping random shale material in spillway excavation (12/2/71).

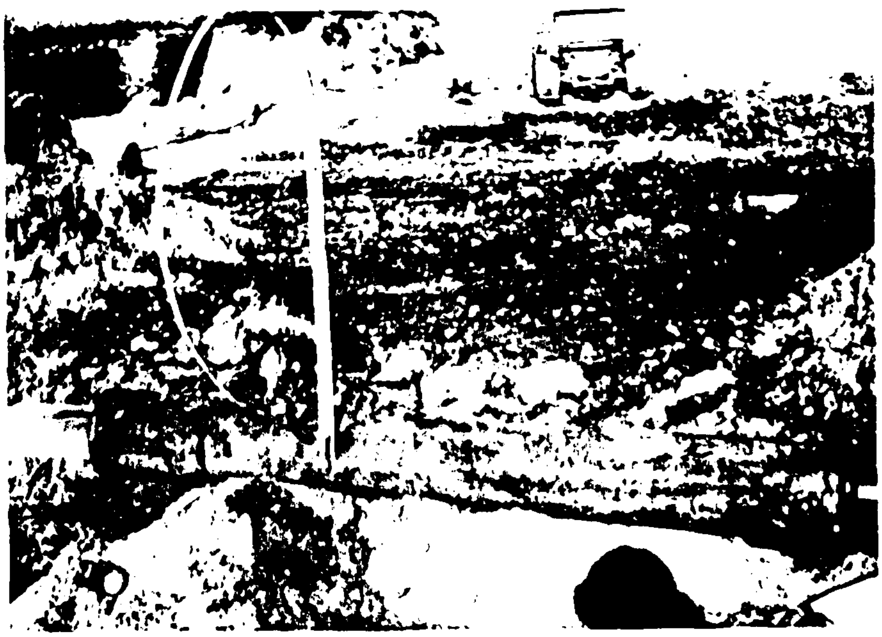


15. Typical operation of excavating relief well galley ditch at Station 14+00 along D.S. toe of dam (12/2/70).

16. View of in-place relief well collector gallery pipe (9/4/72).



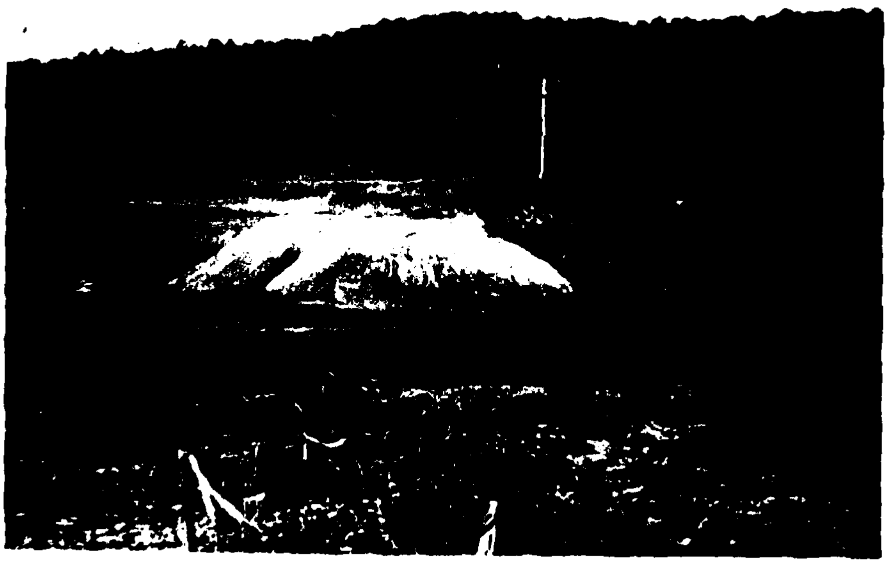
17. View of installing a relief well screen (Feb. 71).



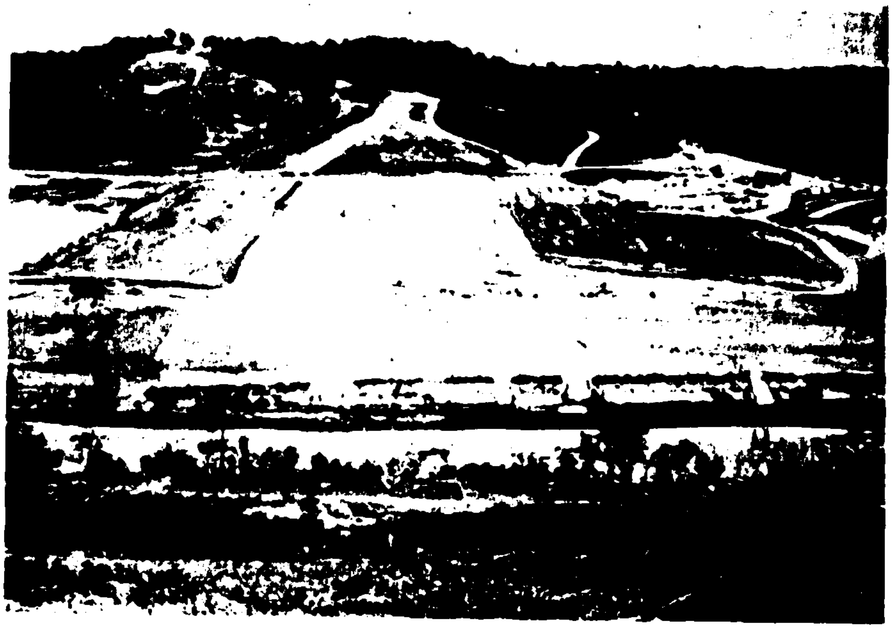
18. View of monitoring by gage flow from relief pump test.

19. View of collector drain pipes for horizontal drains installed in abutment on right side of stilling basin. The bench is elevation 700 (10/1/75).

Progress Photographs



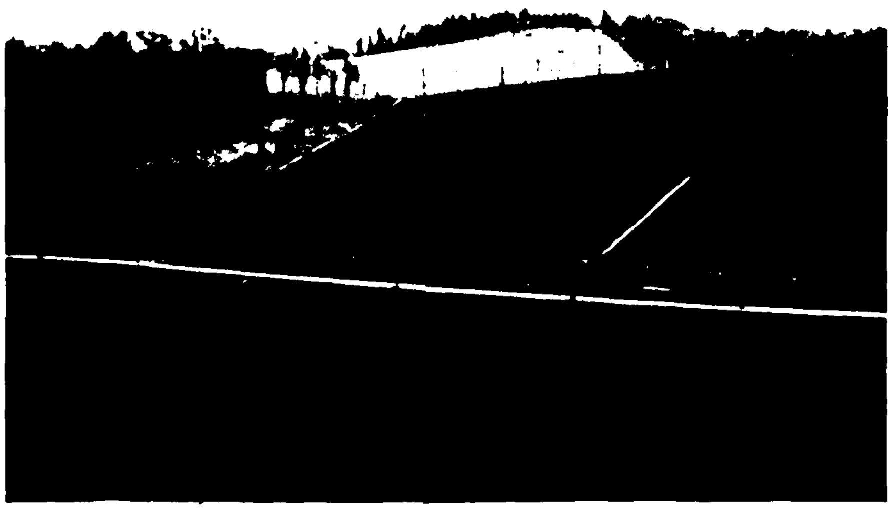
20. View looking ahead of ℄ of dam from Station 2+50 (8/17/70).



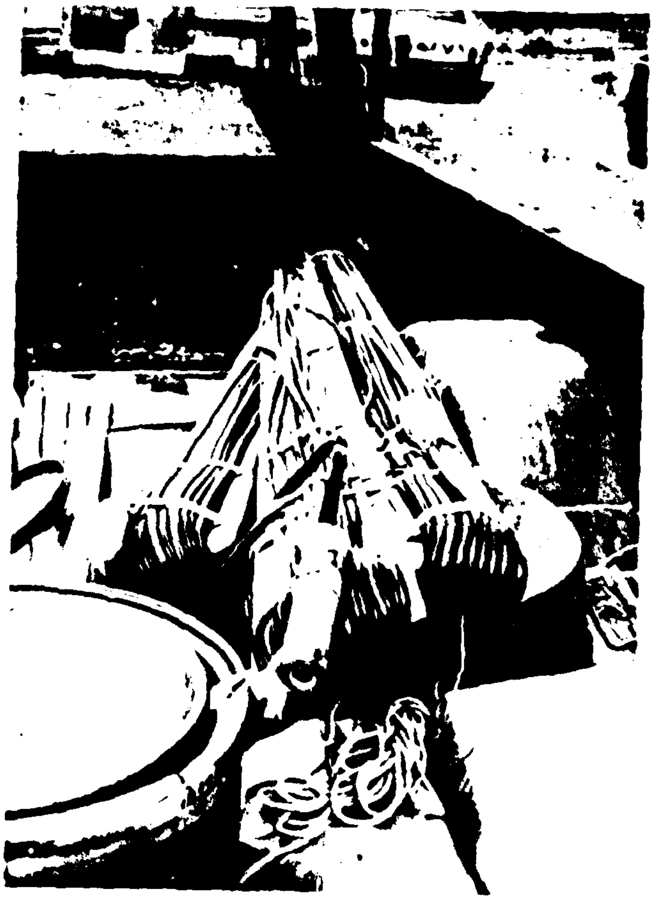
21. View from dam C Station 34+00 looking back station (9/11/70).

22. View from C dam Station 32+50 looking back station (6/17/72).

23. View of permanent cofferdam closure.



24. View from D.S. of embankment looking toward right abutment showing the downstream embankment berm in area of previous river channel (Oct 75).



25. Typical gas-actuated piezometer sensor and tube installed in embankment (8/13/70).

26. Typical 2-foot long porous stone piezometer installed in embankment (4/29/71).

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